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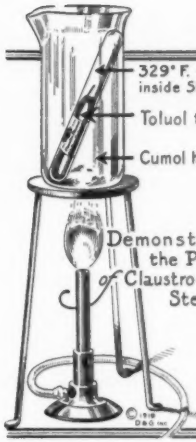
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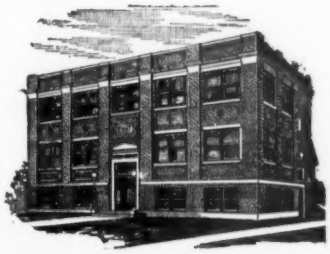

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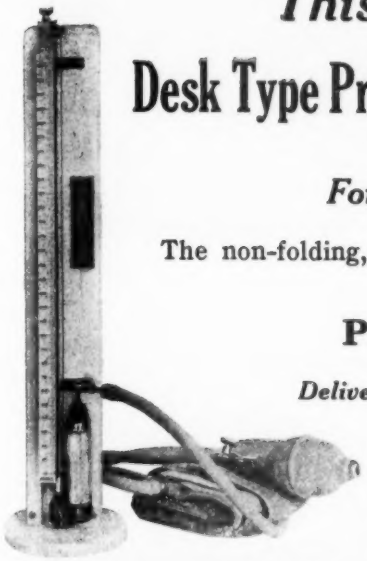

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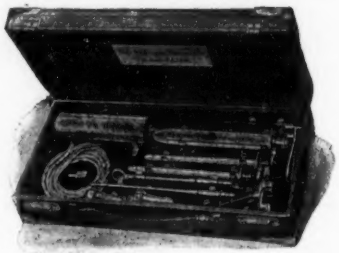

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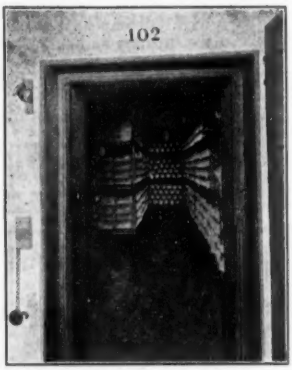

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AMERICAN JOURNAL

OF THE MEDICAL SCIENCES

FEBRUARY, 1920

ORIGINAL ARTICLES

ON THE EPIDEMIC ACUTE AND SUBACUTE NON-SUPPURATIVE INFLAMMATIONS OF THE NERVOUS SYSTEM PREVALENT IN THE UNITED STATES IN 1918–1919: ENCEPHALITIS; ENCEPHALOMYELITIS; POLYNEURITIS; AND MENINGO-ENCEPHALO-MYELO-NEURITIS.[1]

By Lewellys F. Barker, M.D., Ernest S. Cross, M.D.,

and

Stewart V. Irwin, M.D.,

Baltimore, Maryland.

Introduction.

During 1918–19 there has been prevalent in the United States an epidemic disease, now known to be an inflammation of the nervous system, involving predominantly the brain (encephalitis), and sometimes the spinal cord (myelitis), but often involving both brain and cord (encephalomyelitis), or even including also to a certain extent the meninges and the peripheral nerves (meningo-encephalo-myelo-neuritis). Observations of the disease in this country have been reported by K. A. Menninger, Peter Bassoe, Josephine B. Neal, O. L. Pothier, Beverley R. Tucker, Henry M. Thomas, E. W. Schnoor, W. E. Vest, H. Climenko, F. A. Ely, F. Kennedy, A. Gordon, B. Sachs, J. F. Shaw and F. H. Bartlett,

[1] This paper was presented (in abstract) before the Association of American Physicians at its meeting at Atlantic City, in June, 1919, and the abstract will be published in the Transactions of the Association.

F. Tilney and H. A. Riley, P. Wegeforth and J. B. Ayer, V. C. Vaughan, W. C. Allen, P. G. Woolley, I. Abrahamson, H. Belin, C. K. Mills and G. T. Wilson, C. A. Robinson, I. Strauss and S. Hirschfeld, J. A. McDonald, H. S. Howe, P. N. Bergeron, and K. H. Beall.

The epidemic in the United States must, we think, be looked upon as a part of a pandemic occurrence of the same disease, for epidemics closely resembling the outbreak here have been, since 1917, reported in many different parts of the world. The first outbreak to be observed in this pandemic seems to have been that occurring in Vienna in the winter of 1916–17. It was reported by von Economo, who called the malady, unfortunately perhaps, "Encephalitis lethargica." Another outbreak occurred in Australia, especially in Queensland and in New South Wales, in 1917, the "mysterious disease" having been reported in a paper by Breinl. In the spring of 1918 an epidemic of the same disease was recognized to exist in France, where Netter described it as encéphalite lethargique épidémique. Reports of the French epidemic have been made also by Sainton, de Saint Martin and Lhermitte, Audibert, Burger, Etienne, Milian, Oliver, Claisse, and Claude and Schaeffer.

In March and April of the same year (1918) the malady appeared in epidemic form in fifty-one sanitary districts in England, especially in London, Birmingham, Sheffield and Leicester, and was reported by Harris, Hall, Batten and Still, Crookshank, Melland, Christopherson and Mawer, S. A. K. Wilson, E. F. Buzzard, S. K. Vaidya and others. The disease has also been observed in Africa, Ardin-Delteil reporting it in Algiers in 1918. In the latter part of 1917 and in 1918, cases were met with in Uruguay; they have been recorded by L. Morquio, of Montevideo. Several cases have been reported from Ireland by O'Carroll and Nesbitt (1919). Evidently, therefore, the outbreaks recorded in Europe, in Africa, in North America, in South America and in Australia indicate a world-wide distribution of encephalitis in epidemic form.

Personal Observations.

Our own experience in the present epidemic dates from February, 1919; since that time we have had under personal observation several cases in which the diagnosis of acute or subacute encephalitis or encephalomyelitis has been made. Through the courtesy of Dr. H. M. Thomas, of Dr. John Howland and of Dr. Sydney R. Miller, who also have had a number of these patients under their care, we have been permitted to see several additional cases. On account of the great interest attaching to the subject, we shall in this article give the histories of several of the patients observed. In all these cases we have had the advantage of coöperative studies

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made by a number of associates and colleagues; without their aid the data gathered would have, necessarily, been far from complete.

We desire to thank Dr. H. M. Thomas especially for much help in the study of these cases and Dr. Sydney R. Miller and Dr. Walter A. Baetjer for their painstaking laboratory examinations. We trust that the records here presented may, for purposes of comparison, prove helpful to others who have been studying the disease in the United States.

CASE I.—Male, aged twenty-seven years; single; clerical worker; seen February 20, 1919. Referred to office for diagnostic study by Dr. E. R. Dibble, of Marion, S. C.

Complaint. Drooping of eyelids; cannot move upper lip; food accumulates between teeth and cheek; difficulty in swallowing liquids.

Anamnesis (*Summary*). Healthy until present illness, except for an attack of amebic dysentery a year and a half ago and "influenza," followed by diarrhea, twelve weeks ago. Family history practically negative. Smokes ten to fifteen cigarettes a day. Does not use tobacco otherwise, alcohol or drugs.

Three weeks before he was seen he began to see double. At first the diplopia was absent for a short time each morning, but after a few days it became permanent. At about the same time he developed a facial paralysis on the right side, with ptosis and a weak lateral rectus of the right eye. The paralysis of the face extended slowly downward on the right, involving the parts around the lips and under the chin, after which it extended to the left side of the face.

Physical Examination (Dr. Cross). (*Summary*). Patient is about twenty-five pounds below his calculated ideal weight. He is rather pale. Tongue protrudes in midline; a little tremulous. Tags of tonsils on both sides. Superior maxillary arch contracted; moderate amount of dentistry; one or two teeth missing. Small thyroid struma. Slight general lymph-glandular enlargement. Pulse 27 to the quarter; regular in force and rhythm; vessel wall distinctly thickened. Definite fine tremor of the right hand; slight tremor of the left. Blood-pressure: 126 systolic; 80 diastolic. Triangular crines; abundant hirci; definite hypotrichosis of trunk. Both eyelids droop a little—the right more than the left. Neither can be closed tightly. The right eye will not follow the finger to the right; otherwise the eye muscles balance fairly well. The right pupil is much larger than the left; it reacts very sluggishly to light. The left pupil is about normal in size; it reacts fairly well to light. The patient is not able to wrinkle the forehead; lifts eyelids very little; apathetic look; is not able to show his teeth (Fig. 1). Knee-jerks present and about equal. Babinski negative, both right and left. Abdominal reflexes very active. Arm-jerks present. Jaw-jerk definitely a little exaggerated.

Laboratory Reports in Case I.

Blood examination.			No.	Per cent.
Red blood cells	5,212,000	Polymorphonuclear neutrophiles	155	62.0
White blood cells	6,200	Polymorphonuclear eosinophiles	5	2.6
Hemoglobin	90 per cent.	Polymorphonuclear basophiles	1	.4
Red blood cells and platelets normal.		Small mononuclears	56	23.2
No abnormal cells seen.		Large mononuclears	31	12.4
		Transitionals		
			250	100.0

Blood Wassermann Reaction. Antigen (*a*) cholesterinized human heart, negative. (*b*) Acetone insoluble lipoids, negative; (*c*) plain extract of beef heart, negative.

Cerebrospinal Fluid Examination. Wassermann negative, with antigens (*a*) (*b*) (*c*). Cell count, 30. Small mononuclears. Globulin, ++++. Patient anesthetic to puncture.

Gastric contents. 80 c.c. recovered; colorless.	
Free HCl	48.0 acidity per cent.
Combined acid	23.0 acidity per cent.
Total acidity	71.0 acidity per cent.
Occult blood	0
Lactic acid	0
Microscopically, negative.	

Stool Examination. Brown; formed.
Bile, +
Occult blood, 0.
Microscopically, negative.

Urine Examination.

Reaction acid.	Night.	Day.
Specific gravity	1014	1006
Albumin	0	0
Sugar	0	0
Acetone	0	0
Microscopically: Few white blood cells, no red blood cells, no casts.		
Bile	0	0
Blood	0	0
Indican	0	0

Roentgen-ray Reports in Case I. Roentgenoscopic of Chest. Heart of pendulous type; aorta not remarkable. Retrocardial space clear. Lungs and diaphragm negative.

Roentgenoscopic of Gastro-intestinal Tract. Impression, functioning normally.

Roentgenogram of Paranasal Sinuses. Clear.

Roentgenogram of Lungs. A good deal of very fine mottling throughout. Increased fibrosis along the right mediastinal margin, extending up under the right clavicle. Apices relatively clear.

Plate suggestive of slight changes in right lung, as if there had been slight old infection. No fluid present in pleural cavities.

Neurological Examination (Dr. H. M. Thomas). Weakness of the external eye muscles, particularly of the right lateral rectus. Pupils are unequal and the reaction seems to be somewhat sluggish. The patient has partial paralysis of the right fifth nerve and of both seventh nerves. No observable disturbance of sensation. Patient's face has a peculiar set, expressionless look. No spontaneous twitching. Patient elevates the left eyebrow more than the right. Neither is raised as much as it should be. He can wrinkle the forehead scarcely at all. Neither eye can be closed completely. On attempting to elevate the lip there is slight contraction on both sides, but very little movement. Can just begin to pucker the lips. Faradic stimulation of the right facial muscles causes active contraction in the muscles supplied by all the branches of the right facial nerve. The same is true on the left side. With the galvanic current the muscles also contract strongly. Soft palate and tongue normal. Hearing normal. Station and gait normal. Deep reflexes somewhat over-active.

Dental Examination (Dr. H. H. Streett). Mastication much impaired from loss of posterior teeth. Number of cavities to be filled. Superior arch contracted. Roentgenograms negative.

REARRANGEMENT OF THE DATA IN CASE I.

CASE I (No. 5310). Male; aged twenty-seven years; clerk.

Complaint. Drooping eyelids. Loss of motion in upper lip. Difficulty in swallowing fluids.

Habits. Smokes ten to fifteen cigarettes a day.

Previous Infections. Amebic dysentery eighteen months ago. Influenza twelve weeks ago, followed by diarrhea.

Operations: 0. Traumata: 0.

Respiratory System. Tags of tonsils. Lungs negative. Roentgenogram of paranasals negative. Roentgenogram of lungs shows fine spotting in both lungs. More fibrosis on the right.

Circulatory System. Tachycardia, pulse, 108; radials thickened. Blood-pressure $\frac{126}{80}$. Heart negative.

Blood and Hemopoietic System. Red blood cells, 5,212,000; hemoglobin, 90 per cent.; white blood cells, 6200. Wassermann reaction negative (3 antigens). Polymorphonuclear neutrophiles, 62 per cent.; polymorphonuclear eosinophiles, 2.8 per cent.; small mononuclears, 23.2 per cent.; large mononuclears, 12.4 per cent. Slight general lymph-glandular enlargement.

Digestive System. Gastric Analysis. Free hydrochloric acid, 48; total acidity, 71; occult blood negative. Stool negative. Contracted superior arch. Moderate amount of dentistry. One gold cap. Roentgenograms of gastro-intestinal tract negative.

Dentist's report: Infection negative; loss of posterior teeth; cavities, 1.

Urogenital System. Urine: specific gravity, 1006–1014; albumin, negative; sugar, negative; casts, negative; white blood cells, few; red blood cells, none. Nycturia, 1–2.

Locomotor System. Negative.

Nervous System. Three weeks ago first transitory, then continuous, double vision, lasting two or three days. Cannot move upper lip. Food accumulates between teeth and cheek. Difficulty in swallowing fluids. No drooling. Ptosis both right and left. Lids cannot be closed tightly. Right lateral rectus weak; right pupil larger than left; right pupil more sluggish. Cannot wrinkle forehead nor show teeth. Reflexes, ++. Jaw-jerk, +++.

(H. M. T.). Weak right lateral rectus; anisocoria; sluggish pupils; partial paralysis of right fifth nerve and of both seventh nerves; suggests lethargic encephalitis.

Examination of Cerebrospinal Fluid. Clear; cells, 30; small mononuclears; globulin, ++++; Wassermann reaction, negative.

Metabolism and Endocrine Systems. Twenty-five pounds under weight. Small struma. Definite tremor of right hand and slight tremor of left.

DIAGNOSTIC SUMMARY OF CASE I.

1. Poliencephalitis acuta superior et inferior, with slight meningeal irritation. (The case is possibly one of postinfluenzal origin and resembles very much the cases described of late as *encephalitis lethargica.*) There is bilateral ophthalmoplegia and also paralysis involving the right fifth and the right and left seventh, and slightly, the tenth cerebral nerve; the cerebrospinal fluid contains thirty small mononuclear cells and globulin.
2. Gastric hyperacidity.
3. Dental caries.
4. Undernutrition to a degree of about twenty-five pounds.

Discussion of Case I. The localization of the pathological process in the nervous system in this case, at least so far as the chief symptoms and signs are concerned, was easy. The bilateral ophthalmoplegia, the dysmasesia on the right, the bilateral facial paralysis, the dysphagia, and the persistent tachycardia pointed to the gray matter in the midbrain, pons and medulla oblongata containing the nuclei of origin of the III, V, VI, VII, IX (?) and X cerebral nerves, the lesions evidently being more extensive on the right than on the left side. Though there was very slight meningeal irritation (shown by the cell count and the globulin in the cerebrospinal fluid), there was no other evidence to support the view that the paralysis of the cerebral nerves was radicular rather than nuclear; indeed, the absence of any outspoken meningitis and of any symptoms referable to the hypothalamus, the basis pedunculi, the pars basilaris pontis

or the pyramids of the medulla seemed to rule out such radicular involvement. The lesions were evidently in the gray matter of the floor of the aquæductus cerebri (Nucleus n. oculomotorii); and of the floor of the ventriculus quartus (Nucleus [motorius] n. trigemini; Nucleus N. abducentis dext.; Nuclei nn. faciales; and, possibly, Nucleus ambiguus).

The nature of the pathological process we regarded as inflammatory (polioencephalitis acuta superior et inferior with slight myelitis bulbi and slight meningitis), for the mode of onset and course were against apoplexy, thrombosis, and neoplasm.

FIG. 1.—Case I as seen February 20, 1919. Ophthalmoplegia externa et interna; paralysis N. VII, bilateral; paralysis masseter (right); dysphagia; facial mask. (Midbrain; pons.)

As to the etiology of the inflammation, we ruled out lues by the Wassermann test of the blood and cerebrospinal fluid. The absence of tubercle bacilli, of pneumococci, of meningococci and of other bacteria from the cerebrospinal fluid was against infection by these agents. The cell-count in the fluid and the white count in the blood as well as the onset and course of the paralyses did not support the view that we were dealing with an unusual form of the Heine-Medin disease. Recalling the reports from Europe of the prevalence there of epidemic encephalitis, the probability of diagnosis of this disease was then made. Very soon we saw a number of other cases that confirmed this view.

CASE II.—Male; aged forty-six years; married; business man. Referred to office for general diagnostic study by Dr. M. E. Hundley, of Martinsville, Virginia, February 28, 1919.

Complaints. Pain in the head and neck, nervousness, emotionalism, weakness and aching in the legs, insomnia, forgetfulness, irritability and difficulty in walking, all dating from about the middle of November, 1918, just after a period when he had been caring for his family sick of influenza.

Anamnesis (*Summary*). *Family History.* Father died of arteriosclerosis at seventy-six, having had coarse tremor in both hands for forty years before his death, making handwriting impossible, though there were no movements of the head or disturbance of speech; mother living and well; one brother died of pulmonary tuberculosis; one sister has myocardial disease; wife has had one miscarriage. Patient has had nine children, all healthy.

Personal History. Patient had the ordinary childhood infections as well as typhoid; gonorrhea at sixteen; denies lues. At one period he drank hard for eight or nine years, but he has used no alcohol for the past seven or eight years until recently, when he took some on account of insomnia. He has used much tobacco and chews all the time when he is well. He has worked in a room in which tobacco is steamed for ten hours a day for fifteen years. He has taken no vacation in the past fourteen years. For the last six or eight years he has carried strychnin tablets in his pocket, and when he felt let down he would take $\frac{1}{30}$ or $\frac{1}{60}$ grain. He thinks that he averaged an intake of about one dozen strychnin tablets per week.

When asked more in detail about his drinking habits he stated that he drank whisky heavily at about the age of thirty-two. He drank "for the effect," as it stimulated him both mentally and physically. He preferred good whisky and beer, averaging from four to six bottles of beer a day on "beer days" and about $\frac{3}{4}$ pint of whisky on "whisky days." Often he would drink twelve bottles of beer or one quart of whisky in a day. In spite of this he was always able to conduct his business. During ten years of such drinking his weight increased to 195 pounds and his blood-pressure became very high. He often had headaches and he felt badly in the mornings, but he worked hard, and, aside from his work, was well known as a successful local politician.

At the age of forty-two he stopped drinking whisky on his doctor's advice and took no more until the present illness. After stopping drinking his nervousness increased and he says that he became more easily excited and more irritable. His sons, who were rather wild, also worried him at this period. He found that he fatigued more readily than earlier in his life. There were days when he would be very tired and very depressed. In 1918, one son went to France, and this was an additional worry that bothered him greatly.

Present Illness. The patient dates this as beginning about the middle of November, 1918, when he became much more nervous and irritable, lost his temper very easily, became progressively weaker and suffered from aching pains in the legs. The depression

was at this time very hard to bear, and he was constantly tired and sleepy. He "could fall asleep at any time of the day."

During the month preceding the onset of his present illness he had greatly overtaxed himself caring for several members of his family who suffered from influenza. His wife had pneumonia and six of the children had influenzal attacks. The patient, however, during this time remained apparently well, nursing all of the family at night, with only snatches of sleep, and working at his business all day. He states that he chewed tobacco all day and all night, in order to keep awake. He also took a tablet of strychnin every three or four hours, either $\frac{1}{30}$ or $\frac{1}{60}$ grain.

The symptoms noticed at the onset continued to be manifest for several weeks, increasing all the time, until in February he had to give up his work. He noticed that he became very forgetful, had difficulty in locomotion, having to keep his eyes on the ground when walking. He had a dull, heavy feeling in the head and he developed marked tremor of the hands. Two weeks before coming to Baltimore for study he began to be very sleepless. His physician stated that he had had tachycardia recently. The patient complained that his eyesight had become poor and that "reading made his head swim."

Physical Examination (Dr. A. D. Atkinson and Dr. Barker). *Summary.* Patient looks anxious and depressed. Fairly well nourished. Muscles flabby. Looks as though he had lost weight. Hair coarse and dry. Ears and mastoids negative. Pupils a little dilated, left larger than the right; right pupil reacts better to light than the left, though both pupils are rather sluggish on light stimulation and on accommodation. No nystagmus. Teeth suspicious. Tongue protrudes in the middle line. External ocular movements seem normal. Tonsils embedded and adherent. Cervical glands not enlarged. Slight enlargement of the thyroid. Some retromanubrial dulness. Lungs negative.

Radial pulse 26 to the quarter. Blood-pressure: 190 systolic, 120 diastolic. Vessel wall palpable. Heart slightly enlarged, no murmurs. Abdomen negative. External genitalia normal. Deep reflexes sluggish, the right knee-kick being somewhat less active than the left. Gait a little disturbed when walking with the eyes shut. Finger-nose test and heel-knee test well performed. Rather marked coarse general tremor of the head and trunk. Some finer tremor of the fingers when the arms are extended. Prostate somewhat enlarged and firmer than normal; not tender.

Roentgenological Findings. Roentgenoscopic of cardiovascular stripe: Negative except for somewhat transverse position of the heart.

Roentgenoscopic Examination of Gastro-intestinal Tract: Normal findings.

Teleroentgenogram: M. R., 3.4; M. L., 10.4. Heart somewhat transverse in position. Aorta slightly dilated.

Roentgenogram of Paranasal Sinuses. Both antra somewhat hazy, probably old infection.

Reports of Laboratory Tests. Blood. Red blood cells, 5,536,000; hemoglobin, 95 per cent.; white blood cells, 12,800; polymorphonuclears, 87.2 per cent.; polymorphonuclear eosinophiles, 0; polymorphonuclear basophiles, 0; small mononuclears, 9.6 per cent.; large mononuclears and transitionals, 3.2 per cent. Platelets normal. Wassermann reaction in the blood negative.

Gastric Contents. Free HCl, 10 acidity per cent. Combined acid, 34 acidity per cent. Total acidity, 44 acidity per cent. Some occult blood present with both the benzidine and the guaiac tests. Lactic acid, negative. Microscopically, negative.

Feces. Soft and liquid. Negative findings.

Urine. Negative except for a slight trace of albumin and a few white corpuscles.

Cerebrospinal Fluid. Clear; colorless; pressure increased; cell count, 11; small mononuclears. Globulin 4 plus; Wassermann, negative.

Dental Report (Dr. H. H. Streett). General condition of the mouth very bad. Mastication impaired from loss of posterior teeth. Teeth badly abraded and quite sensitive. A number of cavities open to the secretions of the mouth.

Roentgenographic review shows areas of rarefaction about the apices of the superior right first molar No. 3 and central incisor No. 8. As the conditions about these teeth could be foci of infection, they should be extracted and the sockets should be curetted.

Psychiatric Report (Dr. Adolf Meyer). "The patient apparently shows much less well-marked symptoms than he did a week ago. He does not feel depressed; is not uneasy or afraid; shows excellent memory in the usual tests; good grasp of a test story; fair retention. Early in February, however, he had a pronounced depression, with tearfulness easily elicited. He felt he was going to die; he worried about past indiscretions.

As to his physical status the tremor of head and of the hands, with a history of walking with extremely fixed attitude, and with the tendency to loss of balance, either forward or backward, suggests the possibility of an incipient Parkinsonian syndrome.

My impression is that the patient is recovering from a well-marked reactive depression. The important etiological factors are the strenuous work of the last fourteen years and the recent strain during the influenza epidemic, associated with cerebral arteriosclerosis, and the history of an earlier prolonged period of excessive alcoholism."

Diagnosis. Before the report on the cerebrospinal fluid came in we had not thought of the possibility of the existence of epidemic

encephalitis in this patient. Bearing in mind the long history of overstimulation (alcohol, tobacco, strychnin), of excessive application to work and of great family strain, together with the history of arteriosclerosis and marked arterial hypertension, we thought the condition could be explained upon the ground of an atherosclerosis, with chronic renal, cerebral, aortic and cardiac disease. The blood-pressure was 190 systolic and 120 diastolic. He evidently also had oral sepsis. As there was an outspoken facial mask, coarse tremor, a tendency to rigidity of attitude and to loss of balance, we thought that he was suffering from Parkinson's disease, probably due to arteriosclerotic lesions in the globus pallidus. There was a well-marked depression that we looked upon as reactive. He had also signs of a slight thyreopathy.

As the patient had to return home he was advised to have the oral sepsis corrected immediately and to go on a careful dietetic-hygienic regimen, under the supervision of his home physician, and to report to us later on.

Course. The patient stayed at home until May 1, 1919. During the first week or two he improved somewhat, but then rapidly became more nervous, could not lie quiet, had no appetite, and could not sleep. He suffered from "terrible depression" and was very emotional. At this time he started again to take some whisky, but he felt that it did him no good. His physician advised him to return to Baltimore, where he entered a nursing home, had a special nurse, was isolated, was kept in bed at first, and was given injections of cacodylate of soda, massage and a suitable diet. To our surprise the symptoms improved rapidly; the Parkinsonian mask quickly disappeared; the tremor became much less; the depression passed off; the patient resumed a much more normal behavior and his mood became more cheerful.

The following note on the physical condition was made on July 12, 1919, by Dr. M. C. Pincoffs. "Weight stripped, 159 pounds. There has been a distinct decrease in the loss of expressive movements and in the mask-like expression; the patient now laughs readily; there is now no crying even when subjects that formerly would have caused this were brought up. There is still rapid blinking of the eyelids. The eyes, roughly tested with types, show no diminution of vision. Extra-ocular movements normal. No definite von Graefe. There is a marked collar of erythema at the base of the neck and a distinct fulness in the suprasternal fossa. Most of this is a pad of fat, but the isthmus of the thyroid is distinctly thickened, and both lateral lobes of the thyroid are slightly enlarged. The apex-beat of the heart is just lateral from the midclavicular line; the right border is just to the right of the sternal margin. There is a distinct increase in the retrosternal dulness. Heart sounds clear. Rhythm regular. Radials are not thickened on palpation. Pulse-rate 100. Blood-pressure, $\frac{150}{100}$.

The liver margin descends several finger breadths below the costal margin. It is smooth, has rather a firm edge, and is somewhat sensitive. The rather coarse fluttering tremor of the hands formerly present has almost entirely disappeared. There is a persistent fine tremor at present. Knee-kicks active and equal. Biceps reflexes equal. Superficial abdominal reflexes hyperactive and equal. Dermatographia marked.

Impression. (1) The signs of hyperthyroidism of moderate degree are rather predominant in the picture at present. (2) There is well-marked tachycardia, slight dyspnea on exertion and occasional sense of suffocation. The blood-pressure is very labile—$\frac{190}{120}$ in February, $\frac{140}{90}$ in bed, $\frac{150}{100}$ now when resting and $\frac{170}{110}$ on climbing stairs a few days ago. (3) The mental condition is very much improved, the depression and psychomotor retardation so evident at first have largely disappeared. But there is still evidence of an anxiety neurosis and the patient requires constant reassurance.

One might suppose that the encephalitis epidemica had been, in this case, an acute episode in a patient already affected by the results of overwork, chronic alcoholism, chronic tabagism and hyperthyroidism, and that we are now seeing the residual condition with the hyperthyroidism perhaps more prominent than earlier in the course."

Discussion of Case II. The occurrence of asthenia, drowsiness increased nervousness, emotionalism, mental depression and the signs of Parkinson's disease (facial mask; coarse tremor) did not at first call up the idea of epidemic encephalitis in this patient, owing probably to the fact that he had (1) an outspoken atherosclerosis with high blood-pressure, (2) oral sepsis, (3) a history of great strain and fatigue and (4) a long history of overstimulation (alcoholism; tabagism; strychninism). It was the findings in the cerebrospinal fluid that first suggested the superimposition of an epidemic encephalitis upon his other maladies, and a careful consideration of the date of the disease, the conditions and mode of onset, the symptoms and the course, has confirmed us in the opinion that the patient was really infected with the virus of epidemic encephalitis. A striking feature of this case, as in Case III, is the long history of chronic alcoholism. That chronic potatorium predisposes to encephalitis and especially to poliencephalitis superior has long been known. Indeed, Wernicke's type of encephalitis is sometimes referred to as the "acute ophthalmoplegia of drunkards." In our Case II, the process seems to have affected (1) the cortex (amnesia; stupor and later insomnia; depression), (2) the globus pallidus (Parkinsonian syndrome), (3) and, slightly, the midbrain (pupillary changes). He is making a satisfactory recovery.

Case III.—Male; aged forty-eight years; married. Referred for diagnostic study by Dr. W. W. Stewart, of Columbus, Georgia, and by Dr. Allen of Oswitchee, Alabama. Admitted to private ward in

Johns Hopkins Hospital, March 3, 1919. Discharged, April 30, 1919. (No. 5599.) Patient was unable to give a correct statement in regard to his condition, and the history was given partly by his sister, partly by the letters from his physicians at home.

Complaint. Pain in back of neck and head.

Family History. Father died, aged sixty-two years, of softening of brain; otherwise negative.

Personal History. General health always good. No serious illness at any time. Alcoholic for many years, but has drunk less during the last year. Relative told his nurse that for the last ten years he has averaged about one quart of whisky every night! Heavy smoker for a number of years.

Present Illness. About January 21, 1919, the patient felt suddenly weak all over. Pain in back of head, so severe at times that he would grasp his head in his hands and cry out. Mind immediately became affected. Memory was impaired and there was lack of coherence in his talk. No convulsive attacks nor loss of consciousness at any time. Rational periods alternated with periods of delirium. Two days before he was seen he had threatened to commit suicide all of one day. For a few days after onset of illness the face and head "would draw toward the right;" the arms were stiff and were flexed medialward across the chest. For the last eight months he has had sulky spells, and for the same length of time he has been easily irritated and often became angry with members of his family without real cause. His temperature on the first day of his illness was 104°, but it gradually came down to normal on the fourth day. On the sixth day he had numerous "blisters" around the nose and mouth (herpes?). The physician consulted at the onset of his illness knew of the chronic alcoholism, found albumin and casts in the urine and made a probability-diagnosis of uremia (especially as there had been progressively increasing feebleness, rapid loss of weight and mental disturbance at times) and treated the case accordingly.

Physical Examinations (Drs. Barker, Irwin and Ward). The patient looks drowsy and toxic, though when spoken to he answers promptly. Face covered with small pitted scars, resembling those of smallpox. Muscles of mastication and of expression act well and equally. Tenderness on pressure over the entire cranium. No special tenderness over the temporal areas. The left pupil is a little irregular; both pupils react to light and to accommodation, but sluggishly. There are a few small superficial ulcers over the cornea on the left side. Von Graefe's sign is positive. Rosenbach's sign is positive. External ocular movements good. No nystagmus. Slight nasal obstruction on the right side. Marked auditory impairment on the right. Tongue is protruded in the midline; brownish coat; slight tremor. Throat injected; uvula pulled over to right side. Tonsils small; not injected. Gums show active pyorrhea; some dental caries; a good deal of dentistry. No general glandular enlargement. Thyroid not enlarged. Inconstant dry

râles throughout both lungs. Lungs otherwise clear on auscultation and percussion. Heart not enlarged. No heart murmurs. Examination of abdomen shows moderate tenderness on pressure over the gall-bladder and appendix regions. The right rectus muscle is somewhat more tense than the left. Some tenderness on palpation in region of right kidney. Abdominal reflexes present. No abnormalities of genitalia. Cremasteric reflexes present. Sensation on face negative (rough test). No impairment of sensation over upper extremity. Muscular power good; perhaps a little less on right side. Reflexes in extremities present and normal. Rather marked tenderness of calf muscles on left. Babinski equivocal. Muscle sense good. Kernig positive. Brudzynski positive. Coarse tremor of fingers. Marked tenderness in back of neck with some rigidity. Inability to bend head without exquisite pain in neck and back of head. Blood-pressure: 130 systolic; 82 diastolic.

Laboratory Reports.

Blood Examination.

Red blood cells	4,844,800
White blood cells	22,850
Hemoglobin	90 per cent.

Smear, negative for parasites. Wassermann, negative.

Differential count:

Polymorphonuclear neutrophiles	90 per cent.
Polymorphonuclear eosinophiles	1 "
Polymorphonuclear basophiles	1 "
Small mononuclears	2 "
Large mononuclears	5 "
Transitionals	1 "

Cerebrospinal Fluid (First Examination March 7, 1918). Fairly clear fluid; ran out freely, as if under increased pressure. Cell count, 97 small mononuclears. Wassermann, negative in single, double and quadruple quantities. Gold-sol test showed "combined paretic and meningitic curve." Ross-Jones, ++++. Pandy, ++++.

A second lumbar puncture (March 7) showed 133 cells. Differential count showed 98 per cent. lymphocytes and 2 per cent. leukocytes. Smear showed no organisms.

Third examination (April 25, 1919). Clear-looking fluid, apparently under increased pressure; 33 cells per c.mm. Ross-Jones, ++++. Pandy, ++++, Wassermann, negative in single and double quantities. "Luetic type of curve."

Gastric Analysis.

Free HCl	40 per cent.
Combined acid	25 "
Total acidity	65 "

Otherwise negative.

Stool, normal.

Urine. Reaction acid.

Specific gravity	1012–1014
Sediment	+
Albumin	++
Sugar	0

Phthalein, total 70 per cent. in two hours.

Microscopically: red blood cells, many; white blood cells, many. "All kinds of casts." Many epithelial cells.

X-ray Reports. Skull: Sinuses clear. Sella, normal in size and shape. Head otherwise negative.

Teleroentgenogram. M. L., 6; M. R., 4.5; T., 10; L., 12.

Teeth. Radiographic review reveals slight periapical destruction of the cortical layer of the left upper central.

Special Ophthalmoscopical Examination. Examination of eye-grounds show edges of disks distinct. Physiological cup, deep. Cribriform plate, well marked. Veins not full or tortuous. Arteries normal. Retina, as far as seen, normal.

Psychiatric Examination. Impression, delirium of organic type; no definite symptoms pointing to general paralysis; probably a luetic basis (endarteritis) reinforced by chronic alcoholism.

Dental Examination. Radiographic review justifies extraction of left upper central. Pyorrhea should be treated.

REARRANGEMENT OF DATA IN CASE III.

CASE III (No. 5599).—Male, aged forty-eight years; married.

Complaint. Pain in back of head and neck.

Habits. Alcoholic for many years. Heavy smoker for number of years.

Previous Infections. None.

Respiratory System. Inconstant dry râles throughout both lungs. Lungs in back clear on percussion and auscultation. Tonsils small; not infected.

Circulatory System. Pulse-rate for first week around 90; afterward from 70 to 85. Blood-pressure $\frac{130}{82}$.

Blood and Hemopoietic System. Red blood cells, 4,844,800; white blood cells, 22,850; hemoglobin, 90 per cent.; polymorphonuclear neutrophiles, 90 per cent.; polymorphonuclear eosinophiles, 1 per cent.; polymorphonuclear basophiles, 1 per cent.; small mononuclears, 2 per cent.; large mononuclears, 5 per cent.; transitionals, 1 per cent.; Wassermann, negative. Smear, negative. No glandular enlargement.

Digestive System. Tongue covered with brownish coat, tremulous; uvula pulled over toward right side. Some pyorrhea; one tooth showing peri-apical rarefaction. Gastric analysis, negative.

Urogenital System. Urine: Specific gravity, 1012–1014; albumin, ++; no sugar; red blood cells, many; white blood cells, many; all kinds of casts; many epithelial cells.

Locomotor System. Negative.

Nervous System. In present illness, pain in head and back of neck. Mind impaired; talk disconnected. No convulsive attacks nor loss of consciousness. Rational periods alternating with periods of delirium, suggesting "uremic poisoning"; suicidal tendencies.

For a few days after onset of illness the patient's face and head were drawn to the right side. Arms stiffened, flexed and drawn across chest. Staggering gait. Marked auditory impairment. No nystagmus; external ocular movements good. Abdominal reflexes normal. Cremasteric reflexes present. No impairment of sensation over upper extremities. Muscular power good; perhaps a little less on left side. Babinski equivocal. Coarse tremor of fingers. Romberg suggestive. Kernig positive. Brudzynski positive. Marked tenderness in back of neck with some rigidity.

Mononucleosis and globulin in cerebrospinal fluid examination with negative Wassermann and "combined paretic and meningitic gold-sol curve."

Metabolic and Endocrine Systems. Thirty-five pounds under weight. Temperature and pulse normal on admission. Second day temperature went up to 104°. Third day normal; remained normal for two weeks. For following ten days slight rise (99° to 99.5°), after which it dropped to normal and remained so until discharge. Very slightly subnormal at times. For first week tachycardia; afterward pulse 70 to 85. Thyroid not enlarged.

DIAGNOSTIC SUMMARY IN CASE III.

1. Acute encephalitis and meningitis.
2. Chronic nephropathy.
3. Oral sepsis.
4. Undernutrition.
5. Chronic alcoholism.
6. Chronic tabagism.

DISCUSSION OF CASE III. In this patient with chronic alcoholism, progressive weakness, loss of weight, delirium and an outspoken nephropathy, it was natural that the case should have been looked upon at first as one of uremic poisoning. The signs of meningeal irritation (rhachialgia; headache; Kernig; Brudzynski) led to lumbar puncture and the findings in the cerebrospinal fluid ruled out meningococcal, tuberculous and luetic meningitis and pointed strongly to epidemic encephalitis with meningeal involvement.

CASE IV.—Male, aged forty-seven years; business man; single. Seen March 13, 1919. (No. 5550.)

Anamnesis (*Summary*). Always strong. Had scarlet fever in childhood; no sequelæ. Never had typhoid fever nor tonsillitis. When thirty-five, had a bubo following urethritis. This was opened and drained; no sequelæ. Contracted lues when twenty-nine. Treated at different times. For last five weeks, mercurial inunction every other night and mercurial pills internally. Uses alcohol very moderately. Smokes five or six cigars daily.

Father died of dilated heart in course of diabetes. Mother died of cancer of liver. One brother (living) has "traces of diabetes at

times." Four paternal uncles had diabetes; all lived to fair age; youngest sixty-four. No history of insanity nor of epilepsy in the family.

Present Illness. Had influenza in January, 1919, two months before he was seen. Two days after onset of illness, patient noticed numbness of left arm, left loin and left leg. Sugar was found in the urine about ten days later, but it disappeared after a week of strict diet, and there has been no reappearance up to the last urinary analysis, made on March 1, 1919. When asked to describe his numbness he says he "feels as though he was asleep; has pressure along the finger-nails; has a drawing feeling along the sciatic nerve and outer side of left leg." No thirst. No vertigo. Mind active. He says his eyes are apparently normal. He has walked with a slight limp, but has had no other difficulty in locomotion. No apparent loss of sexual desire or power. No frequency in micturition.

Physical Examination (*Summary*). Large man, well developed; inclined to corpulence; florid complexion. Present weight 182 pounds. Ideal weight, 150 to 155 pounds. Cranium normal. No tenderness anywhere. Eye slits narrow. No staring; pupils equal and react fairly promptly to light and accommodation. No von Graefe; no exophthalmos; ocular movements normal. Mouth shows a good deal of dentistry; some retraction of gums; some evidence of pyorrhea. Tongue moist; slightly coated. Pharynx red; a little edematous around the uvula. Both tonsils slightly enlarged, showing evidence of former infection. No tophi in ears. Thyroid not palpable. Thorax well formed; expansion good; lungs clear on auscultation and percussion. Heart normal. Pulse 26 to quarter (erect position); full, bounding, poorly sustained, but not collapsing; easily compressed; apparently little if any thickening of the vessel wall. Hepatic dulness at sixth rib extends to the costal margin; spleen not palpable. Abdomen symmetrical, pendulous; wall flabby; some resistance in right hypochondrium, not marked nor painful. No pain on pressure in the right iliac fossa. Crines and hirci normal. No edema of extremities. Reflexes of left arm seem sluggish; right arm active; feeble abdominal reflexes. Knee-jerks on right side seem normal; on the left side sluggish; plantar reflexes on both sides sluggish. Babinski negative. No clonus. Sensibility acute everywhere despite the subjective numbness. No areas of anesthesia. Equilibrium a little unsteady; coördination a little unstable. External hemorrhoids. Some pain over the prostate; rectum normal.

Laboratory Reports.

Blood.

Red blood cells	5,472,000
White blood cells	10,000
Hemoglobin	90 per cent.
Blood sugar 210 mg. in 100 c.c.	

	No.	Per cent.
Polymorphonuclear neutrophiles	190	76.0
Polymorphonuclear eosinophiles	1	0.4
Polymorphonuclear basophiles	0	0
Small mononuclears	43	17.2
Large mononuclears	16	6.4
	250	100.0

Microscopically: Red blood cells and platelets normal. No abnormal cells seen.

Blood Wassermann Reaction:

Antigen A, cholesterinized human heart—negative.
Antigen B, acetone insoluble lipoids—negative.
Antigen C, plain extract beef heart—negative.

Gastric analysis. 75 c.c. recovered; colorless; much residue.

Free HCl	36 acidity per cent.
Combined acidity	53 acidity per cent.
Total acidity	89 acidity per cent.
Occult blood	0
Lactic acid	0
Microscopically	0

Urine analysis. reaction acid.

Specific gravity	1032
Albumin	Ft. trace
Sugar	0
Acetone	0

Microscopically: A few hyaline casts. No blood cells. Negative for bile, blood, and indican.

Stool examination. Brown; formed.

Bile	+
Occult blood	++
Microscopically	Negative

Cerebrospinal fluid

Pressure	Normal
Cell count	30
Predominant type of cell	Lymphocyte
Globulin	+

Wassermann, negative, with three different antigens.

Roentgen-ray Reports: Chest. Heart about normal size. Diffuse dilatation of aorta. The first curve on the right is particularly prominent. Retrocardiac space clear. Lungs and diaphragm show nothing remarkable.

Gastro-intestinal Tract. No fourteen-hour retention. Stomach of cowhorn type, lying rather high and quite far to the right. Pyloric extremity in apposition with the hepatic flexure, but separable from it. No filling defects; no incisuræ. Hepatic flexure bent rather sharply to the left; not very freely movable. This may be due to obesity. Cecum rather overfull of barium. Transverse colon normal.

Lateral Skull. Sella rather small. Bony outlines not very clear, but the sella is probably negative. The sphenoidal sinus is large; apparently negative. Frontals normal. Tables of skull normal.

Paranasal Sinuses. Slight haziness in the lateral portion of the left antrum. Turbinates seem a little thick.

Teleroentgenogram. M. R. 5.2; M. L., 8.8. Heart slightly enlarged; the aorta moderately dilated. There is a good deal of fibrosis along the mediastinal margins, which tends somewhat to obscure the outlines of the aorta.

Neurological Report (Dr. H. M. Thomas). "I was not able to demonstrate any organic lesion. From the patient's history, however, I have very little doubt that he must have some vascular, or, conceivably an inflammatory condition, somewhere in the sensory path. Such a persistent sensory disturbance suggests a lesion near the optic thalamus, although I have seen it associated with softening in the medulla after occlusion of the posterior inferior cerebellar artery."

Oculist's Report (Dr. Hiram Woods). External appearance, muscle movements, pupillary reactions normal. The optic nerve has a central cup rather deeper than usual, but there is no evidence of nerve lesion. There is a concentric contraction for white and red in each eye. The contraction averages about 15°. However, the retina tired quickly. Central vision is normal, with a low manifest hyperopia in the right eye. The patient's glasses are insufficient. The muscle balance test shows a low grade of combined hyperphoria, with a little tendency outward. *All the muscles, except the externi, are deficient in prism power.* The red glass before one eye which in health has no effect, produces a diplopia corresponding with the balance defect.

Rhinologist's Report (Dr. H. C. Davis). 1. Frontal and maxillary sinuses clear on transillumination; nose and nasopharynx free from any discharge that would indicate infection of the paranasal sinuses.

2. Slight obstruction to breathing on right side, due to deviation of septum to that side.

3. Tonsils quite adherent, otherwise do not show any evidence of infection.

4. Uvula quite elongated, but not at all productive of any symptoms.

Psychiatrist's Report (C. Macfie Campbell). Patient showed a degree of placidity that may indicate a slight change in disposition, but there was no euphoria, expansiveness, nor depression. Orientation was correct; memory of the remote past very satisfactory. Good retention of tests; serial subtraction carried out promptly.

No indication of any distorted attitude toward the external world. There is no evidence in the patient's mental status of mental reduction in relation to the organic episode and no evidence of general paresis.

Urologist's Report (Dr. G. Timberlake). Genitalia normal; no discharge from meatus.

Scar from incised bubo on the right side. The urine shows a few shreds that contain small amounts of pus. Anal sphincter normal; rectum seems normal. Prostate normal for age and history. It is smooth, regular in outline, non-adherent, not tender to pressure; the vesicles seem free but palpable. The prostatic secretion shows marked evidence of chronic inflammation, with a preponderance of pus cells. There was an occasional red cell found, probably the

result of pressure. No superficial evidence of lues, notwithstanding the history. Even with the unusual amount of pus cells in the prostatic secretion, there are no referred urinary, sexual, or general symptoms as a result.

Dentist's Report (Dr. Arthur Lankford). General pyorrhea in both upper and lower jaws. Two bicuspids show badly necrosed condition of alveolus; two other teeth are badly undermined. These teeth are quite loose and are no doubt a source of considerable absorption.

REARRANGEMENT OF DATA IN CASE IV.

CASE IV.—(No. 5550.) Male, aged forty-seven years; single; drygoods merchant.

Complaints. Numbness of left arm, left leg and left loin, with tingling. No loss in motion or strength.

Habits. Cigars five to six a day; alcohol in moderation.

Infections. Scarlet fever at three years; urethritis at twenty-five, followed by bubo that was opened and drained; no sequelæ. Lues at twenty-nine; treatment. Influenza in January, 1919.

Operations. None.

Traumata. None.

Respiratory System. Lungs negative. Roentgenogram of paranasal sinuses shows slight haziness in lateral portion of the left antrum.

Deviation of septum; elongated septum.

Circulatory System. Pulse, 104. No heart murmurs.

Teleroentgenogram: M. R., 5.1; M. L., 8.8. Aorta moderately widened.

Blood System. Red blood cells, 5,472,000; white blood cells, 10,000; hemoglobin, 90 per cent.; Wassermann, negative; polymorphonuclear neutrophiles, 76 per cent.; eosinophiles, 0.4 per cent.; small mononuclears, 17.2 per cent. Blood sugar, 210 mg.

Digestive System. Free HCl, 36. Total acidity, 89. Occult blood, 0.

Stool contains occult blood. Teeth and gums suspicious. Roentgen rays show sluggish colon; ileal stasis. Four or five teeth to be extracted; pyorrhea to be treated.

Urine and Urogenital System. Urine: Specific gravity, 1032; faint trace of albumin; sugar, negative; a few hyaline casts; red blood cells, 0; white blood cells, 0. Chronic prostatitis.

Locomotor System. Negative.

Nervous System. Left-sided numbness appearing in January, 1919. (two days after onset of "influenza"). Pupils active. Paresis of external ocular muscles. Reflexes normal on one examination; slight hyporeflexia on left in another. Some contraction of visual fields for white and red; low hyperopia in right eye; external hyperphoria; glasses insufficient; some eyestrain.

Cerebrospinal Fluid. Normal pressure; cells, 30 small mononuclears, globulin, +; Wassermann, negative. Lesion in sensory path (*q. v.*).

Metabolism and Endocrine System. Glycosuria since January, 1919. Much diabetes in family. Hyperglycemia disappearing after diet. Overweight, twenty-five to thirty pounds.

DIAGNOSTIC SUMMARY IN CASE IV.

1. Residue (left paresthesia and hyporeflexia) of slight cerebral lesion in January, 1919. This may have been a slight encephalitis or a slight vascular lesion; the findings in the cerebrospinal fluid point to encephalitis.
2. Slight atherosclerosis, with slight arterial hypertension (blood-pressure: systolic, 163; diastolic, 94).
3. Oral sepsis.
4. Chronic prostatitis.
5. Obesity, thirty to forty pounds overweight.
6. Hyperglycemia with history of glycosuria.

Discussion of Case IV. We were inclined to look upon the cerebral insult (with lesion in the right cerebrum) at first as of vascular origin, but, later on, concluded that the patient had suffered from a mild attack of epidemic encephalitis because of (1) the low grade of atherosclerosis that existed, (2) the paresis of the muscles of the bulbus oculi and (3) the characteristic findings in the cerebrospinal fluid. Whether or not the glycosuria and the hyperglycemia can be brought under the same rubric is difficult to say. It is of interest to note that there is a marked history of diabetes in the patient's family. Though the patient admitted a luetic infection in his twenty-ninth year, lues can scarcely have been responsible for his cerebral lesion, since the Wassermann reaction was quite negative with three different antigens (and with quadruple quantities of fluid) in both the blood and the cerebrospinal fluid.

CASE V.—Female, aged forty-six years; married. Seen March 17, 1919. (No. 5497.) Referred to office for general diagnostic survey by Dr. George H. Brownfield of Fairmont, W. Va.

Complaint. Influenza seven or eight weeks ago; diplopia for six weeks; trouble in seeing; weakness and nervousness; sleeps poorly.

Family History. Practically negative, except that one sister died from tuberculosis.

Personal History. Has had typhoid "three times," last time twenty years ago. Considered tuberculous in youth; subject to colds. Two children living; one died in infancy; no miscarriages, No operations. No traumata.

Present Illness. Influenza seven or eight weeks ago, accompanied by severe pain in the back of the head. Diplopia for six weeks; slight ptosis of eyelids. In bed most of the time since that illness; weak; nervous; unable to read; depressed. Tongue tremulous. Dizziness; tinnitus; constipation. Her doctor says her mind is not right. She "wanders" at times. She has always worked very hard.

Physical Examination by Dr. Cross. (*Summary*). Patient is twenty pounds below calculated ideal weight. There is a little asymmetry of the lower part of the face; the mouth is drawn a little to the right; there is constant twitching of the upper lip and a good deal of twitching of the tongue. The face is mask-like (Fig. 2). Eyes deep set; they seem a little sunken. The eyelids droop a little; there is some injection of the scleræ. Cheeks a little bulging; acra very prominent. Von Graefe negative. Rosenbach slightly positive. Eyes move upward with a rather jerky movement. Convergence is poor, particularly in the left eye. Slight nystagmic movements in the extreme lateral positions. Pupils rather wide, equal; regular; react to light at present. Tonsils scarcely visible. Much dentistry; numerous gold caps and long bridges. Several teeth missing in inferior arch; some gingivitis. Patient has some difficulty in opening the mouth; she thinks the jaw joints are stiff. There is some thyroid enlargement. Retrocervical glands are palpable, but not much enlarged. Breasts hypoplastic. Apex-beat hard to localize. Relative cardiac dulness does not seem to be increased. Heart sounds clear at apex and base. Pulse, 28 to quarter; regular in force and rhythm; vessel wall a trifle thickened. Radial pulsations synchronous. Hands a little unsteady, but no fine tremor. Blood-pressure: 105 systolic, 70 diastolic. Spine negative. Abdomen of enteroptotic type. Liver dulness not increased; edge of spleen not felt. No special tenderness on palpation. Transverse crines. Hirci medium. Knee-jerks present. Abdominal reflexes normal. Arm-jerks equal and active. Grip good and equal in the two hands.

Laboratory Reports.

Blood.

			No.	Per cent.
Red blood cells	5,856,000	Polymorphonuclear neutrophiles	207	82.8
White blood cells	10,000	Polymorphonuclear eosinophiles	0	0
Hemoglobin	85 per cent.	Polymorphonuclear basophiles	0	0
Red blood cells and platelets normal.		Small mononuclears	32	12.8
		Large mononuclears	11	4.4
No abnormal cells seen.		Transitionals	0	0
			250	100.0

Wassermann, negative.

Gastric Contents:

Free HCl	0 acidity per cent.
Combined acid	30 acidity per cent.
Total acidity	30 acidity per cent.
Acid deficit	5 acidity per cent.

Microscopically, negative.

Stool Examination: Negative.
Urine Examination:

Specific gravity, 1010–1016.
Albumin, 0 at first; later a trace.
Sugar, 0
Microscopically, red blood cells, 0; white blood cells a few at times; Hyaline casts at first; (later absent).

Cerebrospinal Fluid (first examination):

About 25 c.c. clear fluid removed.
Pressure, not increased.
Globulin, +; Ross-Jones test, +; Pandy test, +.
Cells, 2 to entire field (lymphocytes).
No film formed in twenty-four hours.
Wassermann reaction, negative.

Second examination (April 4), made in the private ward at the Johns Hopkins Hospital.

Cells, 7 per cm. (lymphocytes).
Ross-Jones, +
Pandy, +.
Wassermann, negative.
Gold-sol test: Atypical paretic curve.
Spinal-fluid culture showed no growth.

Roentgenoscopic Examination of Chest. Heart is small, of pendulous type. Aorta normal. Lungs and diaphragm not remarkable.

Roentgenoscopic Examination of Gastro-intestinal Tract. No fourteen-hour retention; stomach of cowhorn type, lying somewhat downward and to the right. Good peristalsis. Duodenal cap looks normal. No filling defects; no incisuræ; stomach and duodenum freely movable. Cecum contains a moderate amount of barium. It is easily moved. The transverse colon is prolapsed into the pelvis. The colon seems free of adhesions everywhere along its course. Not much barium in colon.

Roentgenograms of Paranasal Sinuses and Sella. The left frontal sinus is a little hazy, but the ethmoids are clear. The sella turcica is rather small. The clinoid processes tend to approach each other. Bony outline is clear. Sphenoidal sinus negative.

Teleroentgenogram: M. R., 4.2. M. L., 6.2. Heart is about normal size. Aorta shows a very slight widening.

Neurological Examination (Dr. H. M. Thomas). Impression: A typical case of encephalitis lethargica.

Gynecological Examination (Dr. Cullen). Outlet normal; no thickening of Bartholin's glands. Cervix small; points downward. Uterus small; freely movable. One small myomatous nodule felt on the posterior wall. Ovaries not felt. No thickening on either side. Rectal examination negative.

Rhinologist's Report (Dr. S. J. Crowe). Impression: Sinuses do not show any evidence of infection. Good breathing through

each side of nose. Tonsils do not show any evidence of chronic infection.

Dental Report (Dr. H. H. Streett). Patient has lost many teeth; including all the posterior teeth that serve for mastication. There are several crowns and bridges, the abutments of which are vital. Superior right second bicuspid is pulpless but shows no periapical rarefaction. No foci of infection are suspected. A slight gingivitis is present in the upper jaw.

Course in Hospital. Admitted March 18, 1919, discharged April 14, 1919. Through period in hospital, temperature showed an elevation (afternoon) of 99° (a few times 100°). Pulse ranged from 90 to 100 and 110. Weight on admission, 117⅓ pounds; on discharge 123¼ pounds. Steady improvement.

REARRANGEMENT OF DATA IN CASE V.

CASE V.—Female, aged forty-six years; married. (No. 5497.)

Complaints. Influenza seven or eight weeks before; diplopia for six weeks; trouble in seeing. Weakness; nervousness.

Previous Infections. Typhoid fever "three times." Subject to colds.

Operations. None.

Traumata. None.

Respiratory System. Subject to colds. Never had asthma nor hay fever. Thought to be tuberculous in youth. Lungs, nose, throat and sinuses normal.

Cardiovascular System. Radials thickened; low blood-pressure $\frac{105}{70}$. Pulse-rate, 112. Heart, negative.

Blood and Hemopoietic System. Red blood cells, 5,856,000; hemoglobin, 85 per cent.; white blood cells, 10,000; polymorphonuclear neutrophiles, 82.8 per cent.; polymorphonuclear eosinophiles, 0 per cent.; small mononuclears, 12.8 per cent.; large mononuclears and transitionals, 4.4 per cent. Platelets normal.

Digestive System. Impaired mastication. Good digestion. Appetite poor. Sour stomach. No flatulence. No diarrhea. No jaundice. No gall-stones. Slight hemorrhoids. Achylia gastrica. Constipation.

Genito-urinary System. Menses regular. Three children; no miscarriages. Some leucorrhea. Small myoma on posterior wall of uterus. Slight albuminuria and cylindruria.

Locomotor System. General muscular weakness; jaw-joints "feel stiff."

Nervous System. Asthenia; cephalalgia; dizziness; tinnitus; bilateral ptosis; diplopia; poor convergence; accommodation paralysis; twitching and tremulousness of upper lip and tongue; Parkinsonian mask; tachycardia; paresis of muscles of face, especially on left side; tender masseters; globulin in cerebrospinal fluid; history of change in mood, delirium and insomnia.

Metabolism and Internal Secretions. Twenty pounds under calculated ideal weight; slight struma. Normal trichosis. Slight fever.

DIAGNOSTIC SUMMARY IN CASE V.

1. Acute encephalitis.
2. Achylia gastrica.
3. Myoma uteri.
4. Undernutrition.

Discussion of Case V. In this patient the presence of both general and focal symptoms referable to the nervous system, coming on as an "infectious ophthalmoplegia" and "delirium" after

FIG. 2

FIG. 3

FIG. 2.—Case V as seen March 17, 1919. Fever; ophthalmoplegia: left facial paresis; mask-like face; twitching of lips and tongue; nystagmoid movements; tender masseters; asthenia. (Parkinsonian type.)

FIG. 3.—Case V as seen June 1, 1919. At home. Feels entirely well except that vision is still defective. Gain of twenty-one pounds in weight.

influenza, made one think at once of an encephalitis. The pain in the head, the dizziness, the asthenia, the insomnia, the depression and the delirium though pointing to the cerebrum, could scarcely be valued for finer topographical diagnosis. The striking Parkinsonian mask (see Fig. 2) suggested involvement of the nucleus lentiformis (globus pallidus). Otherwise the focal symptoms (ophthalmoplegia externa et interna; twitching of lip and tongue; paresis of left face; tender masseters; tachycardia) pointed to disturbances in the periaqueductal gray matter and the gray matter of the floor of the fourth ventricle (nucleus n. oculomotorii; nucleus

n. trigemini; nucleus n. facialis; nucleus ambiguus; nucleus n. hypoglossi). Lues was ruled out by the negative Wassermann reaction in both blood and cerebrospinal fluid. The patient improved rapidly and left the hospital April 14. By June 1 she had gained twenty-one pounds, looked natural (Fig. 3) and felt well, though partial paralysis of accommodation still persisted.

CASE VI.—Male, aged between fifty and sixty years. Seen in consultation, March 25, 1919, with Dr. Sydney R. Miller, of Baltimore, and Dr. Horace N. Mateer, of Wooster, Ohio.

Complaints. Intense lancinating pains in the trunk and in the lower extremities and marked constipation.

Family History. Negative.

Personal History. Patient has enjoyed good health most of his life. He had the ordinary childhood infections, but no severe, nor any infectious, diseases since. No operations. No traumata. He has suffered from some indigestion for years, especially from gaseous eructations after meals. He has used tobacco in moderation. No history of alcoholism. The patient suffered from a nervous breakdown five years ago (anorexia, insomnia, depression), but recovered after treatment in a sanitarium. Two years ago he suffered from a cerebral insult, having been found one morning in a stupor with some paralysis of the right eye, which subsequently cleared up.

Present Illness. About February 19, 1919, he suffered from severe backache, which came on suddenly and without apparent reason. It was taken to be lumbago by his physician. Despite the pain, he went on a visit to relatives in Pennsylvania, and, on arrival, found three cases of influenza in the house. On February 22 he ate rather freely of chicken livers, which he thought were insufficiently cooked. Next morning he awoke with a severe attack of hiccough, which persisted through the day. On the following day, on waking, he had a feeling of pain and constriction around his waistline on both sides. He attributed this to stiffness and pressure caused by a belt. Examination by a physician at that time revealed no definite abnormality. His temperature then was normal. During the following week he improved somewhat and the girdle sensation grew less. On March 1, however, he began to have severe stabbing pains starting in the back in the region of the left kidney and radiating toward the groin. During two or three days following the pains became more severe, especially in the region of the groin, although they were somewhat less severe in the region of the kidney. The pains next extended down the left leg. At the same time he began to have severe pains in the right groin and leg. Still later the pains extended to the leg between the knee and ankle on the right side, where they became maximal. On March 8, about a week after the onset of the pains, the hiccough returned and lasted three or four days without intermission. The hiccough then ceased and has not recurred since.

On March 12 a nurse was secured, and after this time a regular temperature chart was kept. There was a little fever, reaching a maximum of 100.4° on March 20. At this time he suffered also from sudden and severe pain in the right side of the chest, extending into the right arm. Though there was no cough and no increase of the pain on respiratory movements, the physician in charge thought of the possibility of a dry pleurisy and strapped the chest. At about this time, roentgenograms of the kidneys were made, but no shadows of stone could be found. At the time the hiccough subsided the patient states that he was very drowsy for a period of four or five days, much drowsier the nurse thought than the sedatives given for the relief of pain could account for. The nurse described the patient's behavior as "much like that of a man who is coming out of an attack of drunkenness."

The pains in the right lower extremity have persisted from the onset. They have been more severe at night and have greatly disturbed his sleep. The patient describes the pains as being somewhat intermittent. He states that they are rather superficial, "as though they were in the skin rather than in the muscles or bones." The nurse thought that when she first saw him there was distinct unsteadiness in his gait and a little dragging of the right leg. There has been no history of eye-muscle disturbance.

Physical Examination (Dr. Barker and Dr. S. R. Miller). March 25, 1919. Summary: Patient lies quietly in bed. Does not look ill. External ocular movements normal; no diplopia; right pupil somewhat sluggish; double arcus senilis. Teeth look suspicious. Lungs clear. Heart normal. Low blood-pressure. Abdomen negative. Genitalia negative. No objective disturbances of sensation on rough testing. Muscular strength everywhere good. Knee-jerks somewhat overactive. No actual clonus. Babinski negative. Abdominal reflexes normal. Patient walks with rather a broad base and is somewhat unsteady. Romberg suggestive. Heel-knee test and finger-nose test done well. Calculation good. No disturbance of speech. Lumbar puncture had been done two days earlier and patient felt much better afterward.

Impression. Encephalomyelitis with meningitis and spinal radiculitis.

Laboratory Tests. Blood Wassermann done on March 24, 1919, was negative, with three different antigens. Urine, March 24, negative except for a faint trace of albumin and a good many white blood corpuscles. Cerebrospinal fluid, March 24: clear, colorless, pressure much increased, cell count 48, all small mononuclears, globulin 3 plus, Wassermann reaction negative, with three antigens in quadruple quantity. Second examination of spinal fluid, March 31, showed 14 small mononuclear cells and globulin 4 plus; Wassermann negative. Third examination, April 5: pressure increased, but less than before; 14 cells, globulin 4 plus; Wassermann negative.

Blood examination, March 30, 1919: Red blood cells 4,800,000; white blood cells, 9000; hemoglobin, 85 to 90 per cent. Smear shows nothing abnormal.

Urine examination, March 30: Negative except for faint trace of albumin and many white blood corpuscles; no red blood cells; no casts.

Stool examination, March 30: negative.

Urogenital Consultation (Dr. G. Timberlake), March 31, 1919. Urogenital tract practically negative. Rectum negative.

Neurological Consultation (Dr. H. M. Thomas), April 1, 1919. "The history is remarkable on account of the intense shooting root pains, which give a sharp segmental localization. The patient's description of their running to a certain place on the abdomen and then stopping abruptly is very striking, as is also his description of the gradual increase of the painful area involving segment after segment. A meningeal process must have involved the posterior roots in a descending order. It is also remarkable that the process seems to have been almost exclusively an irritative one and to have left no symptoms of destruction either of the roots themselves or of the substance of the spinal cord, unless the somewhat irregular Oppenheim on the right side be considered as such.

Dictated Note. Patient looks rather listless. Face not mask-like. Can read well with glasses. Eye-grounds negative. Pupils dilated, right more than left. Pupils react directly and consensually to light. Reaction is more active in the left pupil than in the right. Eye movements normal. Masseters normal, not tender. Hearing normal. Facial muscles normal. Jaw-jerks active. Possibly a little weakness of the abdominal muscles. Abdominal reflexes not obtained. Kernig negative. Knee-jerks active and equal. No clonus. Oppenheim positive on the right, negative on the left. No objective disturbances of sensation. When the legs are flexed at the hips the adductor muscles seem to go into a temporary clonus. No pain along the course of the large nerve trunks at present. Station with the feet together now quite steady.

Impression. Epidemic encephalitis, with special involvement of the meninges and spinal nerve roots."

Course. The patient remained in a nursing home for about two weeks and improved rapidly, apparently being much benefited by lumbar punctures and by rest. Dr. Mateer wrote on May 15 that the patient, after returning home had developed no untoward symptoms and was slowly regaining his strength.

Discussion of Case VI. The case was a puzzling one at first, as far as diagnosis was concerned. Except for the acuteness of the onset and the absence of a luetic history the segmental pains suggested the lancinating pains of tabes; and as the pains were worse at night, there had been some unsteadiness of gait and the lumbar puncture showed an increased cell count of small mononuclears and a positive

globulin, a paraluetic process was seriously thought of and preparations were made to give antiluetic therapy. However, the Wassermann test of the blood turned out to be negative, as did also the Wassermann reaction in the cerebrospinal fluid. On reviewing the history, the mode of onset with backache, hiccough and drowsiness, followed by a little fever, acute encephalomyelitis came to mind as a probability-diagnosis, especially as other cases of the disease were being seen at about this time. It was remarkable, however, that there was no paralysis of the eye muscles, with the exception of a sluggish right pupil, and no involvement of the other cerebral nerves. The hiccough suggested an irritation in the region of the phrenic in the cervical enlargement of the spinal cord. The weakness of the abdominal muscles and the temporary disturbance of coördination suggested a possible involvement of the cerebellum or of its connections.

A final consideration of the case leads us to think that there must have been a widespread involvement of the central nervous system and its coverings in this instance, with predominant involvement of the spinal meninges and of the spinal nerve roots. The drowsiness points probably to the telencephalon, the sluggish right pupil to the mesencephalon, the weakness of the abdominal muscles and the incoördination to the cerebellum and its peduncles, the hiccough to the nucleus of origin of the phrenic in the cervical enlargement of the spinal cord and the severe segmental pains to the meninges and to the posterior roots of the spinal nerves. We therefore made a final diagnosis of meningo-radiculo-myelo-encephalitis in this case. The recovery of the patient supports the view.

Case VII.—Colored female, aged thirty-three years; married.

Complaint. "Misery in eyes and head."

Anamnesis: *Family History.* Mother died at forty of heart trouble.

Personal History. Never seriously ill; none of the exanthemata. Occasional headache. Did not have influenza and has had no colds recently. Does not use stimulants. Eight children; five living; no miscarriages. Best weight, 105 pounds, one year ago. Weight on admission 90 pounds (stripped).

Present Illness. One week ago, while working, the patient suddenly felt "dizzy." Then she "saw double." The dizziness passed off; but she has continued to see double. Since then she has had frequent headaches, which are relieved by lying down. Three days after the onset of this illness she noticed a sensation of "grit in her eyes," which has persisted. She has felt weaker than usual and her appetite is poor; otherwise she feels normal, except for her eyes and head. She has not gone to bed in the day-time except to get relief from the headache. She has felt drowsy but the drowsiness has not prevented her from working. She felt sleepy while talking, but only

once fell asleep during conversation. She has had some difficulty in swallowing, and notices that food sticks in her right cheek. Temperature, 99°; pulse-rate 100. Respirations 20. Blood-pressure: 126 systolic, 88 diastolic.

Physical Examinations (Dr. Bloomfield, Dr. Harrop and Dr. Hermann) (*Summary*). Eighth day of disease. Patient has distinctly mask-like expression. No disturbance of smell nor of vision. Complains of diplopia, the two images being very close together. No obvious strabismus. There is a distinct sluggishness and uncertainty in the movements of all the eye muscles. The bulbs can be moved pretty well, however, medialward and downward. There is very little upward movement and slow, incomplete lateral movement. Distinct incoördination of bulbs on looking to the side. Pupils are equal. Distinct weakness of the motor branch of the fifth nerve. Slight facial asymmetry and drooping of the right eyelid. Facial movements seem a little weaker on the left side than on the right. Hearing is normal. No sign of bulbar involvement. No stiffness of neck.

Kernig negative. Strength of arms and legs good and equal. Reflexes normal except right knee-kick is a little more active than the left. There is sweating about the mouth and nose, largely confined to the right side. Eye-grounds normal. Impression: lethargic encephalitis.

Laboratory Reports.

Blood.	No.		Per Cent.
Red blood cells	6,326,000	Polymorphonuclear neutrophiles	76
White blood cells	9,120	Polymorphonuclear eosinophiles	1
Hemoglobin	77 per cent.	Polymorphonuclear basophiles	1
Blood culture. No growth. Wassermann, negative.		Small mononuclears	13
		Large mononuclears	9
		Transitionals	0

Throat Culture:

Nasopharynx, negative for influenza bacillus.

Cerebrospinal Fluid:

Bloody.

Pressure, not increased.

Culture showed *Staphylococcus albus* (probably a contamination).

Urine Analysis. Reaction acid:

Specific gravity, 1022–1024.
Sugar, 0.
Albumin, 0 (faint trace once).
Microscopically epithelial cells and white blood cells. No acetone. No guaiac.

Roentgen-ray Reports. Sinuses; negative.

Specialists' Reports. Neurologist. Pupils regular and equal. React fairly to light and slugglishly to accommodation. Unable to read for

a week previous to examination. Visual fields show concentric contraction (rough determination). Extra-ocular movements limited laterally both to left and right. Normal in other directions, but slow and jerky. No spontaneous internal strabismus, but medial rectus lags on right side when looking far to left.

Nystagmus when looking to the right. Marked lacrimation. No exophthalmos. Slight ptosis of right eyelid. Muscle strength of lids equal, but poor. Ophthalmoscopic examination negative. Jaw muscles rather weak on both sides. Patient wrinkles brow, whistles, etc., quite well. There is a slight flattening of the naso-labial fold on the right. Gait is slow, but otherwise normal.

Electrical Tests. Branches of the facial nerve respond normally to faradic stimulation on the right side. On the left side all branches respond, but require a stronger current. The orbicularis oris reacts to direct stimulation, much better on the right than on the left. On both sides the orbicularis oris contracts, with a quick sharp contraction to galvanic stimulation.

Neurologist's Report (Dr. H. M. Thomas). Patient has a peculiar set facies. There is still marked weakness of upward and downward movements of eyelids and eyeballs. Accommodation probably paralyzed. Masseters still sensitive. Otherwise conditions are normal (April 2, 1919).

REARRANGEMENT OF DATA IN CASE VII.

CASE VII.—Female, aged thirty-three years; married; eight children, five living. No miscarriages.

Complaints. "Misery in eyes and head."

Previous Infections. None.

Operations. None.

Respiratory System. Negative.

Circulatory System. Negative.

Blood System. Red blood cells, 6,328,000; white blood cells, 9120; hemoglobin, 77 per cent.; polymorphonuclear neutrophiles, 75 per cent.; polymorphonuclear eosinophiles, 1 per cent.; polymorphonuclear basophiles, 0 per cent.; small mononuclears, 16 per cent.; large mononuclears 7 per cent.; transitionals, 0.5 per cent. (Second examination, April 25): Red blood cells, 6,512,000; white blood cells, 9820; hemoglobin, 75 per cent. Differential Count: neutrophiles, 76 per cent.; polymorphonuclear eosinophiles, 1 per cent.; polymorphonuclear basophiles, 1 per cent.; small mononuclears, 13 per cent.; large mononuclears, 9 per cent.; transitionals, 0. Blood culture negative.

Digestive System. Negative.

Nervous System. Pupils regular and equal; react fairly to light but sluggishly to accommodation. Accommodation paralysis. Diplopia. Visual fields show concentric contraction. Limitation

of extra-ocular movements to left and right. No spontaneous internal strabismus, but right eye fails to move adequately when looking far to the left: Nystagmus to right. Marked lacrimation. Slight ptosis of right eyelid. Ophthalmoscopic examination negative.

Diagnosis. Encephalitis non-purulenta epidemica.

Discussion of Case VII. The onset in this case was entirely typical with headache, dizziness, diplopia, burning or gritty sensation in the eyes, asthenia and drowsiness. The ophthalmoplegia pointed to the midbrain (nucleus n. oculomotorii), the facial mask to the globus pallidus, the lethargy to the cerebrum, the facial and trigeminal paresis to the pons, and the headache to the meninges. In colored people, we are always on the lookout for tuberculous and for luetic meningitis, but the laboratory findings ruled both out. The patient made a good recovery.

Case VIII.—Female, aged fifty-two years. Referred for diagnostic study, April 14, 1919, by Dr. J. W. Preston, of Roanoke, Va.

Complaints. Loss of weight, depression, nervousness, and a little fever every day.

Anamnesis:

Family History. Negative.

Personal History. Never very strong; had a severe fall on her abdomen at sixteen; suffered from peritonitis in 1892 and in 1900 had her appendix removed, one ovary removed and uterus suspended. She has had amenorrhea for the past eighteen years. The patient says that she has always been energetic and very interested in anything in which she is engaged. She has had domestic worries for some years, and during the past two years has gradually lost weight and has suffered from indigestion, insomnia, depression and anxiety; during this time, she once consulted a psychiatrist, who made a diagnosis of "psychasthenia with unreality complex."

Present Illness. One month ago, while in Florida, she began "to see double;" this diplopia was accompanied by nausea. She went to bed for two or three weeks and every afternoon her temperature rose to 100°. During this time she was very drowsy; she felt sure she "must be being doped," especially during one week. Since then she has been unusually weak, has suffered from dyspnea on exertion, has had tinnitus in the left ear and has been a little dizzy.

Physical Examination (Dr. Sydney R. Miller and Dr. Barker, April 14, 1919). Patient is about ten pounds under ideal weight; looks pale; external ocular movements seem normal; no diplopia at present; left pupil a little larger than the right, but regular in outline; pupils react to light and accommodation, somewhat sluggishly. Moderate arcus senilis. Nasal obstruction on the left. Much dentistry; long history of pyorrhea; many suspicious teeth.

Tongue is protruded in the middle line; tongue very tremulous. Pharynx negative; tonsils small. No general glandular enlargement. Thyroid not enlarged. Pulse 21 to the quarter, regular; radials not thickened; blood-pressure: systolic, 114; diastolic, 70. Lungs negative. Heart negative except for slight tachycardia and a little accentuation of the pulmonic second sound. Old appendix scar in the abdomen; slight abdominal tenderness on pressure; liver and spleen not enlarged. Deep reflexes active. No edema.

Laboratory Reports.

Blood.

			No.	Per cent.
Red blood cells	5,408,000	Polymorphonuclear neutrophiles	176	70.4
Hemoglobin	97 per cent.	Polymorphonuclear eosinophiles	1	0.4
White blood cells	17,600	Polymorphonuclear basophiles	1	0.4
		Small mononuclears	57	22.8
		Large mononuclears and Transitionals	15	6.0
			250	100.0

Blood culture: Negative.
Microscopically: Red blood cells and platelets normal. No abnormal cells seen.
Blood-Wassermann Reactions: April 16, 1919.
Antigen A: Cholesterinized human heart, negative.
Antigen B: Acetone insoluble lipoids, negative.
Antigen C: Plain extract of beef heart, negative.

Gastric Analysis:

25 c.c. recovered; normal color.

Free HCl	32 acidity per cent.
Combined acid	13 acidity per cent.
Total acidity	45 acidity per cent.
Occult blood	0
Lactic acid	0

Microscopically, negative.

Stool Examination:

Bile, +
Occult blood, 0
Microscopically, negative.
Brown, formed.

Urine Analysis:

	Night acid.	Day acid.
Specific gravity	1014	1004
Albumin	0	0
Sugar	0	0
Acetone	0	0
Microscopically few white blood cells.		
Indican	0	0
Bile	0	0

Roentgen-ray Reports. Chest: Negative.

Gastro-intestinal Tract. Negative except for cecal stasis and some ileal retention in the six-hour plate.

Paranasal Sinuses. Negative.

Sella Turcica. Negative.

Psychiatric Report (Dr. Adolf Meyer). "The examination of this patient shows that she is under a very great strain, dependent altogether on an adjustment of a problem which she has not personal control of. The reaction became intensified during the wedding of her daughter last August and the patient has since then, in February, gone through a condition which suggests an abortive encephalitis, but which was evidently closely connected with exacerbations of the continual dread of the recurrence of the matters which upset her so. There is no special difficulty of concentration or memory; no fundamental and unshakable mood disturbance, and I feel convinced that the removal of the cause for uneasiness through radical treatment of the one more directly at the bottom of the condition will yield a satisfactory and lasting result. I should urge a rest period away from the existing cause."

Neurological Examination (Dr. Henry M. Thomas). Patient's voice is normal. Pulse rather rapid; beats at 96. Blood-pressure, 110. Ophthalmological examination. Right optic nerve: Edges are all distinct; physiological cup is not well marked; veins normal in size; there is some pulsation in the central vein; arteries a little tortuous; no marked sclerosis; retina, as far as seen, normal. Left optic nerve: Temporal edge distinct; nasal edge can be made out; is not so clearly seen; upper border is somewhat obscured; veins are of normal size; arterial walls glistening; these are rather small and have a tendency to obliterate the veins.

Pupils equal; react to light directly and consensually and contract during accommodation.

Movements of the eyeballs excellent to the right, left, up and down. Convergence normal.

Muscles of mastication act well and equally. They are not particularly sensitive to pressure.

Jaw-jerk present, not exaggerated.

Sensation on face normal.

Facial muscles act well and symmetrically. Patient has no difficulty in puckering lips and in whistling.

Hearing is acute in both ears.

Soft palate acts equally on the two sides, but not very actively. Tongue is protruded straight; it is slightly tremulous.

Movements of the hands are coördinate. There is no noticeable tremor. Muscular strength is what would be expected.

Biceps and triceps reflexes present and equal. No trouble in recognizing objects placed in hand.

Station with feet together and eyes closed is quite steady.

Abdominal muscles act strongly. Abdominal reflexes are not obtained.

Knee-heel test is done very well on both sides.

Muscular strength of legs is excellent.

Knee-jerks present, equal, not exaggerated. Ankle-jerks present, equal, not exaggerated.

Plantar stimulation gives plantar flexion.

Impression: "The patient's history interests me. She seems to have had a very mild attack of lethargic encephalitis. I could, however, find no present evidence of any permanent defect. For the rest, she is in a highly neurotic, depressed condition, due, I think, to her family worries. She certainly needs an upbuilding treatment."

Dental Report. Roentgenographic review of the mouth shows No. 9 the left superior central, No. 10 the left superior lateral, No. 11 the left superior canine to be periapically infected; they are pulpless teeth, well filled, but they should be extracted and the sockets should be curetted. Replacement is possible on present denture. Bridge "A" should be sectioned between the left inferior first molar No. 19 and the left inferior second bicuspid No. 20. The left inferior second molar No. 18, No. 23 the left inferior lateral, No. 24 and No. 25 the inferior centrals, No. 26 the right inferior lateral, No. 28 and No. 29 the right inferior bicuspids, are periapically and gingivally involved; they should be extracted and the sockets should be curetted. Replacement is possible by removable denture. These teeth could be active factors for focal infection. Those teeth allowed to remain are very important for the retention of the denture and for occlusion.

Gynecological Report (Dr. T. S. Cullen). "I do not find any marked tenderness at any point in the abdomen, though she says there is a slight feeling of soreness. The outlet is moderately relaxed; the cervix is back; the body of the uterus is small but in perfect position; it has probably been attached to the anterior abdominal wall. On the left side, and apparently attached to the uterus, is a globular mass about 3 cm. in diameter, which would correspond to a normal ovary or to one that was just a little enlarged. I can find nothing in the pelvis that will in any way account for the slight fever, and there is nothing in the vagina or pelvis to warrant my suggesting any operative procedure."

Ophthalmological Report (Dr. Hiram Woods).* "The patient told me about the moderate "elevation of temperature" dating back some time, and of the presence of "pus in the urine," also of occasional "attacks of burning in the eyes," and, about two months ago, the occurrence of diplopia. This gradually wore off in the course of a month and was accompanied, in its later stage, and followed, by stupor; she says that "she slept for days like one dead." Shortly after getting about her glasses were changed, the last ones being twice the strength of the old. Now the new glasses are uncomfortable and the weaker ones are more satisfactory.

Examination revealed normal media and fundus; pupils of equal size with normal reaction—possibly a little sluggish—but this is not of much importance save as fitting in with my theory that she

has had an encephalitis. She has no manifest refraction error and only a very little hyperopia. It does not need correction for distant vision. Omitting the old "burning" and the moderate fever, both of which may be due to some focal infection, the recent history of diplopia, the temporary decrease in accommodation and the stupor correspond quite closely with what I have seen in some cases of encephalitis recently. The double vision is due to insufficiency of the lateral recti, and, I think, especially of the left. I lent her glasses from my trial case, correcting her presbyopia."

Nose and Throat Examination (Dr. H. C. Davis). Examination negative except for deviated septum and oral sepsis.

REARRANGEMENT OF THE DATA IN CASE VIII.

Chief Complaints. Loss in weight; nervousness; fever daily.

Infections. "Peritonitis," 1892.

Operations. Traumata. Severe fall on abdomen at sixteen; one ovary and part of other removed in 1900; also appendix removed and uterus suspended; 1895 D. and C.

Respiratory System. Left nasal obstruction; lungs, 0. Deviated septum. Roentgen rays: paranasals, 0. Lungs: Old tuberculosis in right upper; no signs of activity now.

Circulatory System. Dyspnea and palpitation at times; pulse, 84; heart, negative; blood-pressure, $\frac{114}{70}$.

Blood and Hematopoietic System. Red blood cells, 5,408,000; hemoglobin, 97; white blood cells, 17,600; Wassermann, 0; polymorphonuclear neutrophiles, 70.4; polymorphonuclear eosinophiles, 0.4; small mononuclears, 22.8.

Digestive System. Free HCl, 32; total acidity, 45; occult blood, 0; stool, 0. Pyorrhea; bowels regular; two years ago indigestion began; heavy feeling; suspicious teeth; slight diffuse abdominal tenderness. Roentgen rays: Sluggish gastro-intestinal tract.

Dental. Ten teeth to extract. Pyorrhea.

Urine and Urogenital System. Urine: specific gravity, 1014, 1004; alb., 0; sugar, 0; cyl., 0; white blood cells, few; red blood cells, 0.

Menopause, seventeen years ago; pyuria once; nocturia, 2 to 3.

Gynecologist: Globular mass on left; probably ovary attached to uterus.

Nervous System and Sense Organs. Trouble in left Eustachian tube for one year; family worries for years; some time ago consulted psychiatrist; evidently "psychasthenic state, with unreality complex"; few weeks ago, double vision, very drowsy, afternoon fever; in bed two to three weeks; left tinnitus for three months; left hippus; slight anisocoria; active pupils; moderate arcus; tremulous tongue; abdominal reflexes absent.

Ophthalmologist: Slight hyperopia and presbyopia; evidently has had encephalitis; ordered reading glasses.

Psychiatrist: Under great strain; evidently recent abortive encephalitis.

Neurologist: Nervous condition; evidently has had mild lethargic encephalitis.

Metabolism and Endocrine System. Fever since September, 1918; undernutrition 8 to 10 pounds; tremor; roentgenogram of sella negative.

Course. The patient entered a nursing home, where she had the ten infected teeth extracted and the pyorrhea treated, and where she received general upbuilding treatment and psychotherapy. After the extraction there was for a time a rather marked anemia. The blood examination on May 16, 1919, showed:

Red blood cells	3,600,000
Hemoglobin	70.0 per cent.
White blood cells	3000
Polymorphonuclear neutrophiles	72.4 per cent.
Polymorphonuclear eosinophiles	1.2 per cent
Small mononuclears	18.0
Large mononuclears and transitionals	8.4

There was slight anisocytosis; the platelets were reduced.

Though the patient was very psychasthenic during her stay, she improved steadily and has gone to a cool place to spend the summer.

Diagnosis. 1. Convalescence from mild epidemic encephalitis.

2. Oral sepsis: ten teeth to extract; pyorrhea to treat.
3. Psychasthenic state.
4. Refraction error.
5. Moderate undernutrition.

Discussion of Case VIII.—The diplopia, the abducens paresis, the anisocoria, the stupor and the low grade of fever, followed by asthenia and by an exacerbation of a long-standing psychasthenic state led us to the diagnosis of a mild encephalitis, especially as the symptoms appeared at a time when encephalitis was epidemic. Unfortunately, owing to the protest of the patient, no examination of the cerebrospinal fluid was made in this case. The oral sepsis, the psychasthenic state, the undernutrition, and the secondary anemia were more important as therapeutic indications than the mild encephalitis.

(*To be concluded*)

CONCERNING SPINAL CORD TUMORS AND THEIR SURGICAL TREATMENT.[1]

By Charles A. Elsberg, M.D.,
NEW YORK.

Frequency and Level. Spinal tumors occur most often outside of the cord. They originate either from the cord itself, from the spinal membrane or from the soft tissues surrounding the dura. Of 67 spinal tumors operated upon by the writer, 49, or almost three-fourths, were extramedullary, and 18, or one-fourth, were intramedullary. In 42, or 62 per cent., of the cases the new growth occurred inside of the dura mater.

TABLE I.

Level.		Extramedullary.	Extradural.	Intramedullary.	Totals.
Cervical	1	2	..	..	2
	2	..	..	1	1
	3				
	4	..	..	1	1
	5	2	..	2	4
	6	3	..	2	5
	7	1	1	5	7
	8	1	..	..	1
Dorsal	1				
	2	5	1	1	7
	3	..	2	1	3
	4				
	5	1	1	..	2
	6	1	..	..	1
	7	1	..	..	1
	8				
	9	3	1	3	7
	10	3	..	2	5
	11	3	1	..	4
	12	3	..	..	3
Lumbar	1	2	..	..	2
	2				
	3				
	4				
	5				
Conus and cauda	..	11	..	..	11
Totals		42	7	18	67

Spinal tumors are met with most often in the cervical and dorsal regions and between the roots of the cauda equina. Thus of the 67 cases of our series, in 27 the tumor lay somewhere between the

[1] From the Surgical Services of Mount Sinai Hospital and the Neurological Institute, New York. Tumors of the spinal cord, spinal membranes and those of the soft tissues which have grown into the spinal canal and have caused compression of the spinal cord are here considered. Primary and secondary malignant growths of the vertebræ and ribs are not included.

fifth cervical and the third dorsal and in 21 between the ninth dorsal and first lumbar segments; in 11 between the lower end of the spinal cord and the roots of the cauda equina. The extramedullary growths occurred with about equal frequency at the cervicodorsal and dorsilumbar levels, while intramedullary tumors were met with twice as often in the cervicodorsal as in the lower levels of the cord.

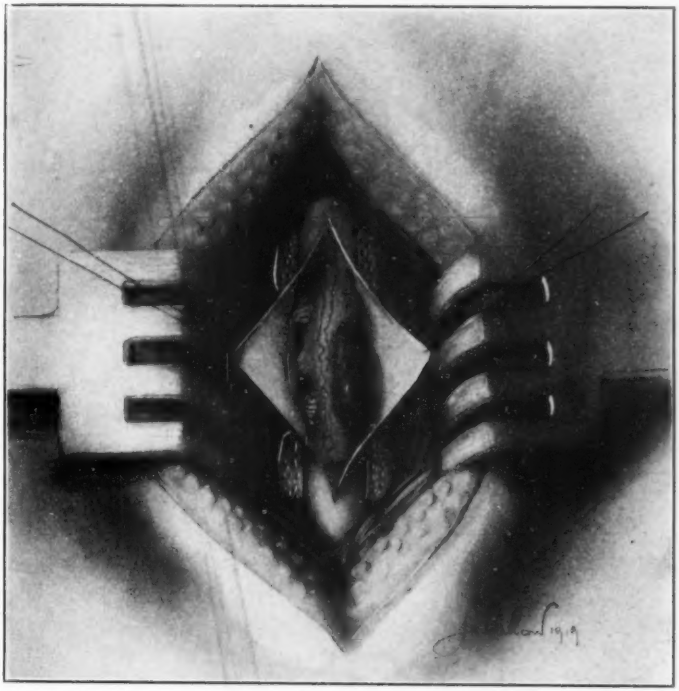

FIG. 1.—Spinal cord tumor (fibroma) on the posterior surface of the cord near the median line.

THE RELATIONS OF THE TUMOR TO THE SPINAL CORD AND TO ITS SURROUNDINGS. Tumors are most frequently met with on the posterior aspect of the spinal cord. They often lie in or near the median line over the origins of the posterior spinal nerve roots; they may develop more to one side of the cord behind the roots of that side (Figs. 1, 2 and 3).

As the dentate ligament marks the boundary between the anterior and posterior halves of the cord, any tumor that develops behind the dentate ligament must be considered as lying on the dorsal aspect of the cord. Some growths develop in front of the posterior roots,

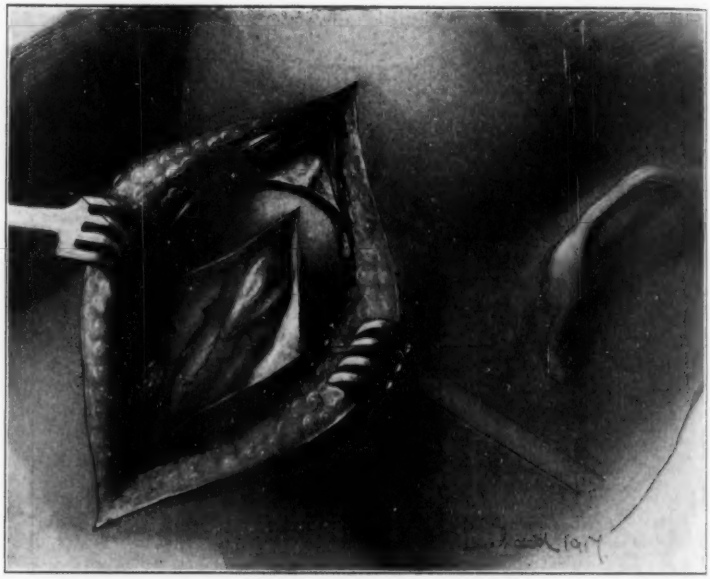

FIG. 2.—Mrs. G. Intradural dermoid cyst lying on the posterior surface of the upper cervical cord and projecting into the posterior cranial fossa.

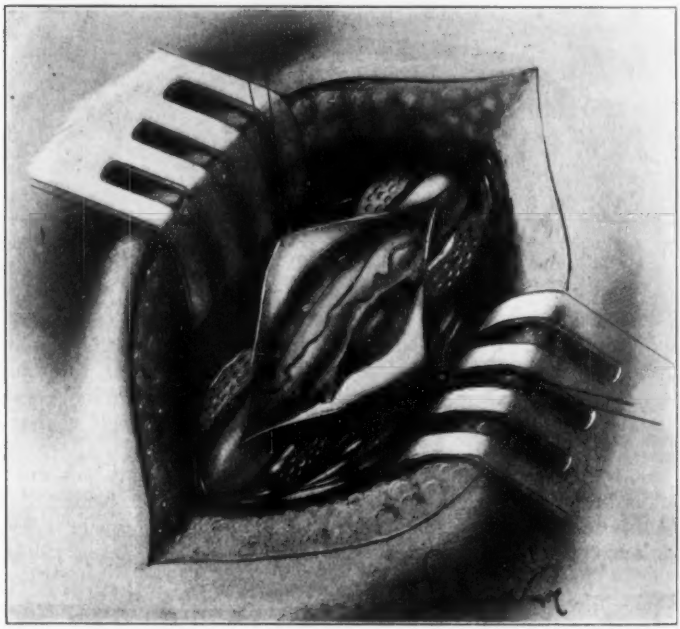

FIG. 3.—F. G. Extramedullary tumor lying behind a posterior spinal root on the side of the spinal cord.

but behind the dentate ligament, and these stretch the posterior roots as they enlarge (Fig. 4). These growths are most liable to cause severe root pains from the beginning of the symptoms. In a patient with a suspected spinal cord tumor, unilateral root pains, followed by cord symptoms, for a long time referable to that side of the cord, justify the probable diagnosis of a cord tumor which has developed under one or more posterior spinal roots.

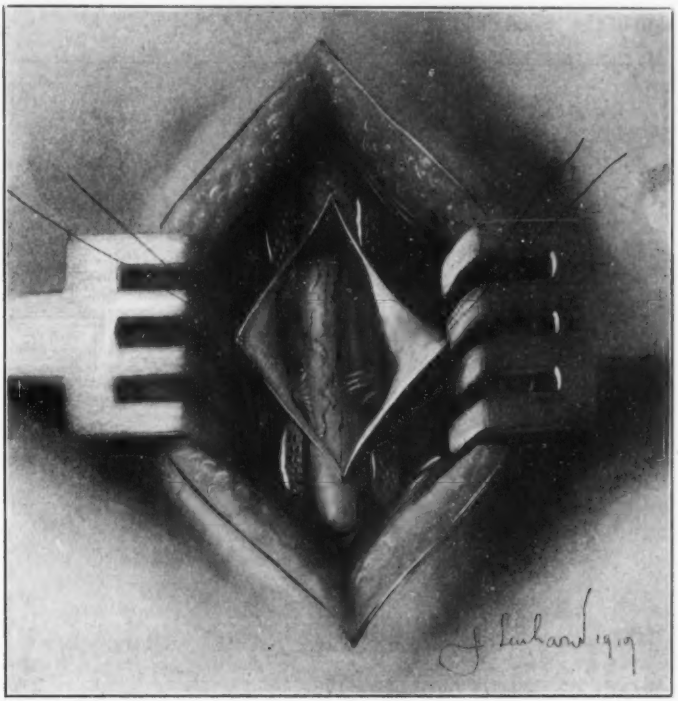

FIG. 4.—Extramedullary tumor lying in front of a posterior spinal root.

If these patients are seen in a relatively early stage of their spinal cord symptoms a typical Brown-Séquard syndrome may be observed. While an indication of a Brown-Séquard picture—more motor disturbances on the same side and more marked loss of sensation on the opposite side—is seen in all but the advanced stages of the disease a typical Brown-Séquard syndrome is most liable to occur in these extramedullary growths which develop posterolaterally between the dentate ligament and the posterior spinal nerve roots. These tumors develop either from the pia arachnoid covering of a posterior spinal root or from the general pia or arachnoid. Un-

doubtedly they often increase in size very slowly, so that many months and perhaps years may elapse before they have grown sufficiently to compress the spinal cord.

The dentate ligament probably offers considerable resistance to the forward enlargement of the new growth, and the nerve roots may be so tightly stretched over the latter that they have to be divided by the surgeon before the tumor can be removed. These lateral growths are liable to push the spinal cord markedly to the opposite side of the spinal canal.

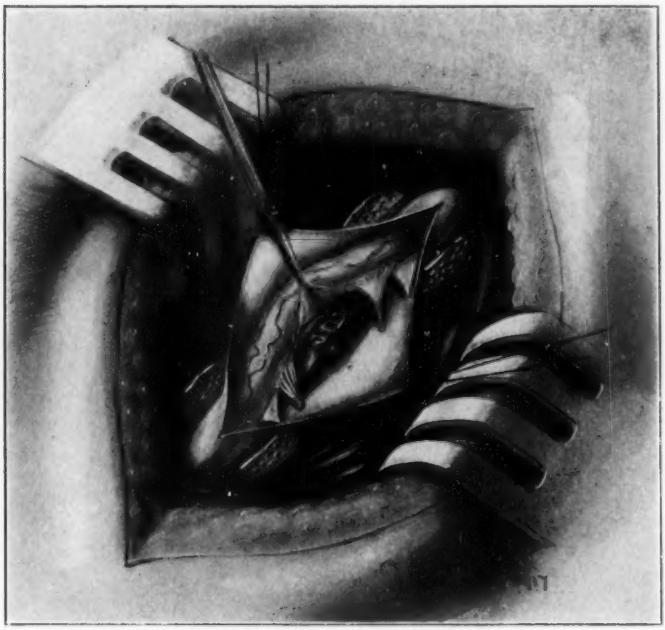

FIG. 5.—Extramedullary tumor lying on the anterolateral surface of the cord in front of a slip of the dentate ligament.

Of the 31 extramedullary (intradural) tumors of our series above the level of the cauda equina, 24, or 77 per cent., lay either on the posterior surface of the cord or posterolaterally, and 14 of the 18 cases of intramedullary tumor seemed to occupy more especially the posterior parts of the spinal cord.

In 7 patients with extramedullary tumors (33 per cent.) the growth was found either anterior or anterolateral to the cord. Here again the tumors may develop either in front of the spinal cord and the anterior spinal roots or anterolaterally between the anterior roots and the anterior surface of the dentate ligament. When these

growths are exposed by the surgeon they are usually found to be covered, on their posterior surface, by the dentate ligament or one of its slips. Usually, one of the attachments of the ligament to the inner surface of the dura has to be divided and the ligament has to be retracted before the tumor can be sufficiently exposed for its removal (Figs. 5 and 6).

These anterolateral growths only rarely begin with root pains; their course is often a painless one and it is frequently difficult to differentiate them from intramedullary growths.

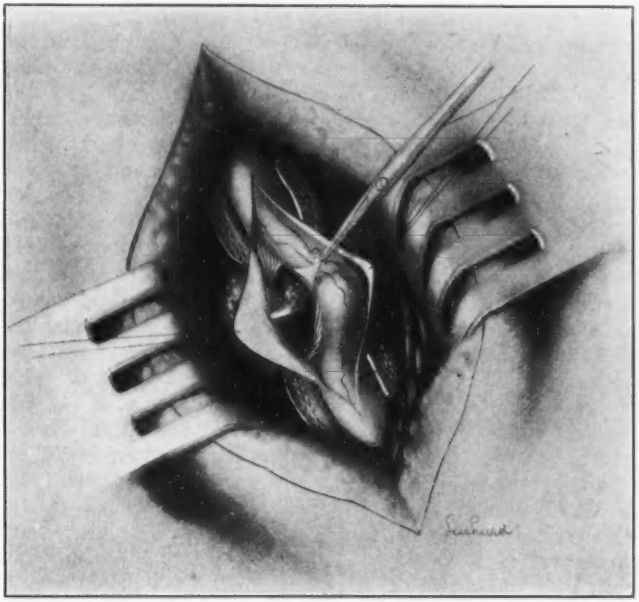

FIG. 6.—Exposure of a tumor lying in front of the spinal cord by traction on a slip of the dentate ligament. (Note that the growth is an extension of an extradural tumor.)

It is often impossible to decide upon the part from which an extramedullary tumor has originated. If a growth is attached only to the inner surface of the dura it has very probably originated from that membrane. Likewise, if the tumor is not adherent to the dura and does not involve any nerve root it must be derived either from the arachnoid or pia mater; in this connection it is well to remember that tumors which arise from the pia are much more closely adherent to the cord than arachnoid new growths.

If the tumor is found to be adherent to several of these structures its origin cannot be determined with certainty. It is sometimes very

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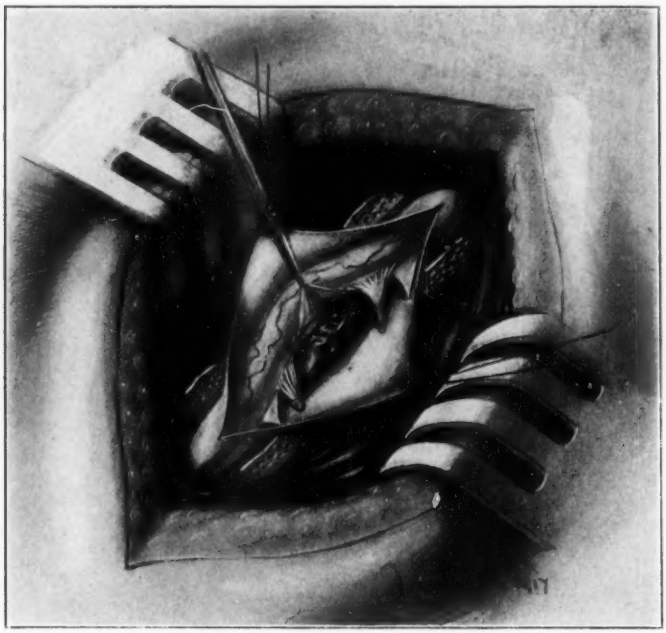

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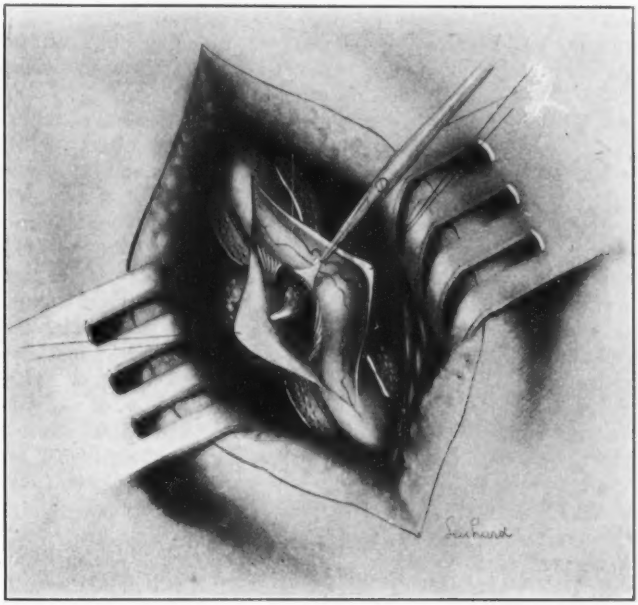

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If the tumor is found to be adherent to several of these structures its origin cannot be determined with certainty. It is sometimes very

difficult to differentiate between a subpial or septal newgrowth and a true intramedullary one. These septal and subpial tumors may be surrounded on all sides by cord tissue, and for their removal an incision into the cord may be required. It may very well be possible that some of the growths we have described as intramedullary were really examples of septal or subpial tumors which had grown into and become buried, as it were, in the tissue of the cord.

INJURY TO THE CORD BY A TUMOR IN ITS PROXIMITY. Every expanding lesion within the spinal canal will, sooner or later, exert pressure upon the spinal cord, but the amount of compression is not directly proportionate to the size of the growth or its duration. Large tumors are more liable to be of softer consistency than small ones, and it is the small, hard tumors that cause, in many instances, early severe damage to the cord structure.

It is often impossible to determine from the appearance of the cord at the time of the operation how great the actual damage has been. Nor can deductions be drawn from the symptoms and signs which the patient presents. If a flaccid paraplegia with loss of all reflexes is present, or if such a condition has existed for a considerable period, it is very probable that the cord lesion is an irremediable one. This does not mean, of course, that there may not be some return of power and of reflexes after the removal of the tumor, but the chances for an amount of improvement that will be functionally valuable for the patient are very slight. The majority of these patients with advanced signs of cord compression, however, have a spastic paralysis which is either a paraplegia in flexion or in extension. Some of the patients, even after years of spastic paraplegia, begin to improve after the removal of the tumor and may recover a very satisfactory amount of power; others never improve enough to gain even a small amount of control of their limbs. When the tumor is in the cervicodorsal region the improvement of the upper extremities may be very marked while that of the lower limbs may be very slight.

The lumbosacral cord is very vulnerable as far as the centers for the bladder and rectum are concerned, and loss of control of urine and feces may persist even after the disappearance of all other symptoms.

From the appearance of the cord at the time of the operation no conclusions can be drawn regarding the amount of improvement that can occur. As it is always inadvisable to handle or even touch a part of the cord that has been subjected to pressure for a long time the operator can seldom determine the exact condition of the affected cord. It is quite astonishing, however, how great an improvement may occur in a cord that appears at operation, to be flattened to a thin tape size. As I have already stated, much greater improvement may be expected in a flattened cord than in one in which there is a deep depression from a small hard tumor (Figs. 7 and 8).

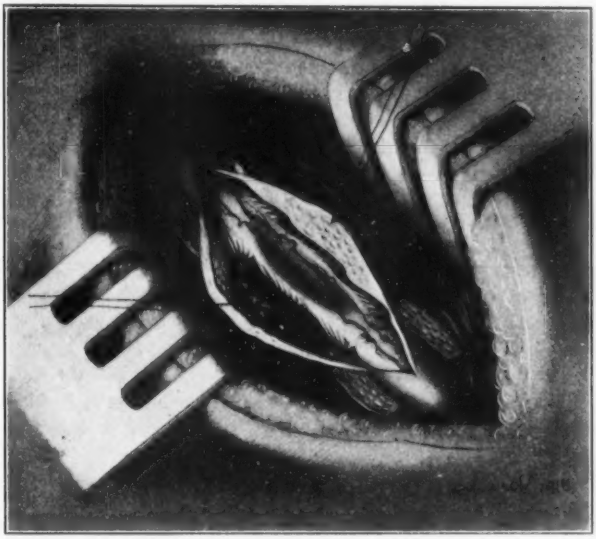

FIG. 7.—E. S. Dural endothelioma which has markedly flattened the cord.

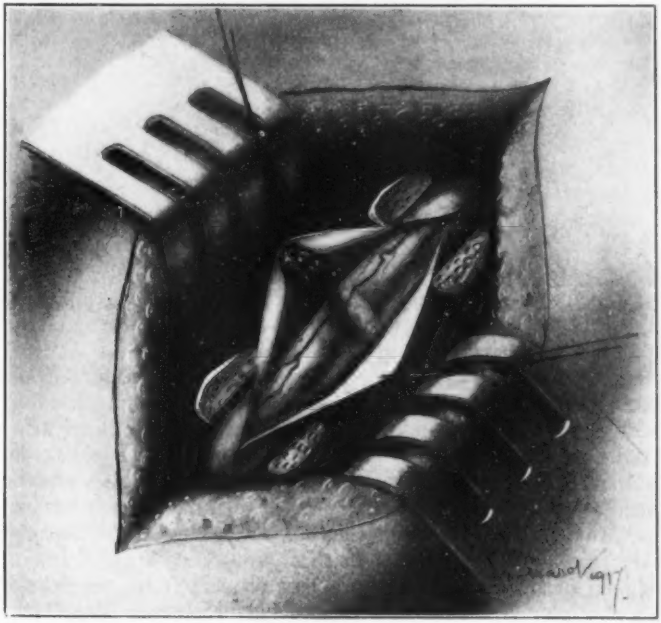

FIG. 8.—Mrs. H. Small dural fibroma which has caused a localized depression in and softening of the cord.

It is never possible to say what improvement will follow the removal of a localized intramedullary growth by the method of "extrusion." We have seen some excellent recoveries but have had many disappointments. The majority of intramedullary tumors are infiltrating in character and the destruction of cord tissue is usually extensive.

What has been said of the tumors that compress the spinal cord holds true, in a general way, for those that develop between the roots of the cauda equina. As the lower end of the spinal canal is

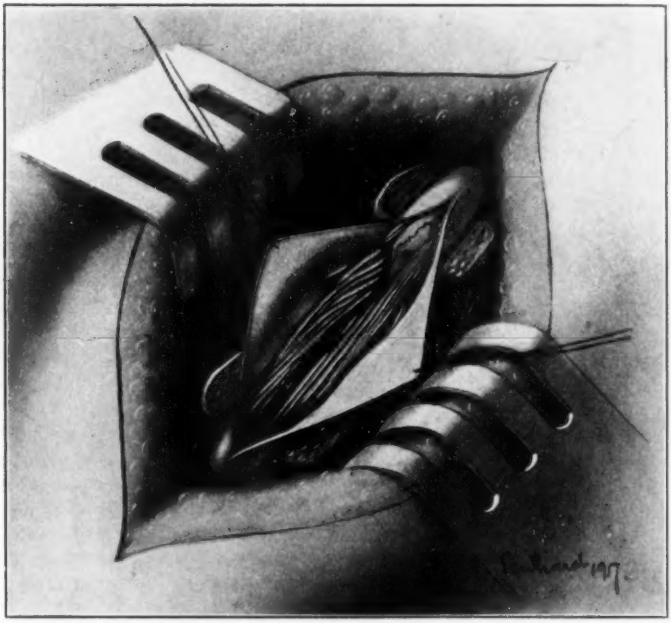

FIG. 9.—Mrs. R. Small tumor, under the left roots of the cauda equina, compressing the conus.

relatively large the tumor must have attained a considerable size before all of the caudal roots are affected. The most frequent form of newgrowth in the caudal region is one which is soft, and which attains a very large size, and is usually firmly adherent to the different nerve roots. To entirely remove these large growths would require the resection of a number of the nerve roots, which is, of course, not permissible or an amount of handling of the roots which would be tantamount to their destruction. Small tumors between the roots of the cauda equina are relatively rare (Fig. 9) and the injury to the nerves can be fully recovered from. It is

remarkable, however, how little sensory disturbance may be caused by the large tumors which so often fill up the entire lower end of the spinal canal and envelop each and all of the nerves of the cauda equina.

Concerning Diagnosis. The diagnosis of an extramedullary spinal cord tumor, when the symptoms and signs are well marked, is, in the majority of instances, comparatively easy for those experienced in this field, and most of the patients were sent to us, for surgical interference, with the diagnosis of "cord tumor" already made. The most frequent difficulty experienced was to distinguish between true spinal cord neoplasm and malignant vertebral disease, because malignant disease of the bone may be slow in its development, the onset of the spinal symptoms gradual and the roentgen-ray picture negative. The diagnosis is not difficult if there is a history of primary disease in some other part of the body; but in the cases of primary vertebral disease or at least a disease of the vertebræ in which no primary lesion in any other part of the body can be discovered, the diagnosis is often difficult.

The back of every patient in whom a spinal tumor is suspected should be carefully examined. In patients who are unable to sit up and who have to be turned on the side, we have sometimes found a small swelling to one or the other side of the vertebral spines only after repeated examinations.

Although the spinal cord symptoms which occur with malignant disease of the neighboring bones are usually sudden in their onset and progress within a few days to a complete flaccid paraplegia, the symptoms may develop more gradually. In these patients the differential diagnosis may be difficult. We do not know, in many of the cases, whether the spinal symptoms are due to a toxic or circulatory softening of the cord, because in not a few instances the malignant growth has not made any direct pressure upon the spinal cord.

The diagnosis of "spinal cord tumor" was made more and more early as we gained greater experience with these cases. Many patients had to be watched for months or years before the diagnosis could be made, for a neuralgia has no significance so far as the spinal cord is concerned until some symptoms referable to the spinal cord have appeared. Many of our patients had been, of course, treated for neuralgias or for vertebral diseases for considerable periods, and some had been operated upon for suspected intra-abdominal conditions before the cord symptoms had become manifest.

The diagnosis of "intramedullary tumor" is more difficult, and in many of the patients upon whom a laminectomy for intramedullary disease was performed by us we were uncertain as to whether the disease within the substance of the cord was neoplastic or degenerative.

Of the 67 patients in our series the diagnosis of tumor was made or

suspected 60 times; in the 7 other patients a tumor was considered one of the possibilities. In order to obtain a fair idea of the diagnostic possibilities, however, all of the operated patients should be mentioned in whom a tumor was considered either certain, probable or possible. In all there were 105 patients in this category. In 70 patients the diagnosis of tumor was made or considered probable and in 60 of the patients a tumor was found at the operation. In 35 patients a tumor was considered possible but not probable; in only 7 of these was a tumor found at operation, and 5 of the 7 patients had an irremovable intramedullary growth. The 28 patients in whom a tumor could not be excluded and in whom an exploratory operation was performed, suffered from one of the following conditions: malignant disease of the spine, pachymeningitis, adhesive arachnitis, neuritis of the cauda equina, multiple sclerosis, gliosis, funicular myelitis, abnormal spinal vessels with intramedullary disease. Thus it will be seen that, in our experience, the diagnosis of "spinal cord tumor" was made correctly in the majority of the patients (60 out of 70 cases). When the diagnosis could not be made but a neoplasm was considered possible, though not probable, there was no tumor in most of the patients (28 out of 35 cases).

In the majority of instances the tumor was found at or near the suspected level. Table II shows that in all but three of the patients the tumor was found either at the suspected level or no more than three segments higher or lower than had been diagnosticated. In all of these patient the growth was exposed after the removal of several additional vertebral arches.

TABLE II.

Total number of cases	67	
Level diagnosis correct	48	
Level diagnosis too low:		
1 segment	8	
2 segments	4	
3 segments	2	
10 segments	2	(removed at second operation).[2]
Level diagnosis too high:		
1 segment	1	
2 segments	1	
6 segments	1	(removed at second operation).[2]

[2] These cases will form the subject of a paper on The False Localizing Signs of Spinal Tumors, which will be published by Dr. I. Strauss and myself.

In one patient the level symptoms pointed to a lesion at the sixth dorsal segment, but the tumor was found at a second operation at the twelfth dorsal segment. In two other patients the diagnosis of a tumor at the level of the twelfth dorsal segment was made. The operation failed to expose the growth. A year or more later, in each patient, there were clear level symptoms in the cervical region,

and in both instances I removed the tumor from the lower cervical region at a second operation.

THE SURGICAL TREATMENT. If an extramedullary tumor has been exposed by laminectomy and incision of the dura its removal does not, in most instances, present any technical difficulties. If the growth lies on the posterior surface of the cord and is not adherent to that structure it can often be "picked out" of the spinal canal with the division of perhaps only a few fine adhesions. If, on the other hand, it lies under a nerve root or in front of the dentate ligament or the cord itself the manipulations must be very carefully accomplished. It is always inadvisable to attempt to pull out a tumor from under a nerve root, as such a procedure might cause serious injury to the cord. Either the nerve root or roots must be carefully raised and pulled apart by fine strabismus hooks, or if sufficient room cannot be gained the roots must be divided.

Similarly the surgeon should never attempt to pull out a tumor from under a slip of the dentate ligament. The slip should be divided and retracted in order to expose the newgrowth. When a tumor is to be removed from in front of the cord the following procedures are of value: By the division of one or two slips of the dentate ligament and of one posterior nerve root (if necessary) the cord can be pulled well to one side. This should be done with forceps which grasp the slips of the dentate ligament which have been divided and not by direct pressure upon the cord. The operator should never make the attempt to pull the cord to one side by means of traction on one or more nerve roots. A pull on a nerve root sufficient to draw the cord to one side is almost certain to injure the cord itself.

Another important detail in the exposure and removal of tumors which lie in front of the cord is to remove much more of the laminæ on one or other side, so that the access to the front of the cord from that side is made more direct.

If the neoplasm is found to be closely adherent to the cord the greatest possible gentleness should be used in separating it from that structure. Tumors which have originated from the pia mater on the cord are sometimes so firmly adherent that in their removal a small layer of cord tissues would come away with the growth. If the adhesion is a very firm one it is preferable to leave behind a small piece of the capsule of the growth.

If the neoplasm is not found at the exposed level a careful search must be made for it. The appearance of the veins on the posterior surface of the cord is very characteristic when there is an obstruction to the return flow of blood at a higher level. In addition a probe should be carefully passed upward and downward on the posterior and anterior aspects of the cord. An elastic resistance is often felt when the end of the probe impinges upon a tumor higher up or lower down than the exposed area. Mistakes may, however, occur

when the end of the probe is caught in a nerve root, in an adhesion between the arachnoid and the dura or is obstructed by a swollen cord or one of the normal curves of the vertebral column. If there is no escape of cerebrospinal fluid from above and such an elastic resistance to the progress of the probe is encountered, especially if there is a venous congestion of the cord, a tumor at a higher level than that exposed is very probable.

Operative Results. In order to obtain an adequate idea of end-results a careful study of each case is necessary. Many of our patients have recovered completely and have remained well, others have retained symptoms that were more or less disturbing to them; still others have remained subjectively well, although examination showed that some neurological abnormalities had persisted. Then there were the patients in whom, on account of long duration of the disease or of advanced cord compression, little or no improvement followed the removal of the tumor. Finally there was the group in which removal of the growth could not be accomplished. Some of these patients have been much relieved by the decompressive effect of the operation, while most of them were of course not improved. We have been able to "follow up" a large number of our patients and shall, in the near future, report in detail on our "end-results."

In this paper I shall speak only of operative results as summarized in the following table:

TABLE III.

Relation of tumor to cord.	No. of cases.	Tumor removed	Tumor partly removed.	Tumor not removed.	Deaths.	Recovery.	Per cent.
Extramedullary	31	31	—	—	2	29	=94
Cauda equina	11	1	8	2	2	9	=82
Extradural	7	3	1	3	1	6	=86
Intramedullary	18	4	2	12	2	16	=89
Totals	67	39	11	17	7	60	=90

Many physicians still believe that the operation of laminectomy is a very dangerous one, but the statistics of those who have had experience in this special field show that the danger of a spinal operation is not very great. Thus of the last 200 laminectomies performed by the writer, 12 cases ended fatally, a mortality rate of 6 per cent. The mortality of the operation of laminectomy and removal of a spinal cord tumor should not be large. Of 67 patients in our series, 7, or 10.4 per cent., died after the operative interference; in the operations for extramedullary tumors there was a mortality of 6 per cent.

Two patients with extramedullary cord tumors died four days after the removal of the tumor; an old diabetic (sugar-free before the operation) died on the fourth day in diabetic coma; the other patient was a very stout woman, aged sixty-four years, who succumbed to an ether pneumonia on the fourth day after the operation. Two patients with tumors of the conus and cauda equina died, one

of them five days after operation from necrosis of the wound and sepsis, the other four days after the surgical interference in coma with a hemorrhagic nephritis. The fifth patient was a child of four years, with a large extradural sarcoma which was found to be an extension of a large malignant growth of the right chest. The patient died in shock twenty-four hours after the removal of the growth in the spinal canal. The sixth and seventh patients had high cervical intramedullary tumors. One patient had an intramedullary infiltrating glioma in the upper cervical cord that was an extension downward of a tumor in the posterior cranial fossa. The growth could not be removed and death occurred on the third day from respiratory paralysis. The other patient was a woman with respiratory and cardiac symptoms from a localized intramedullary tumor of the third to fifth cervical segments. This was one of our earliest cases, and after incision of the cord I removed the tumor at the first operation. The patient died from respiratory paralysis two hours after the operation.

A study of these fatalities will show that we have operated upon some patients in whom surgical interference should have been refused; they were operated upon in the beginning of our experience with spinal surgery. It was certainly hopeless to attempt to remove an infiltrating growth, such as in Case VI, or to remove in one stage an intramedullary tumor, as in Case VII. The child with an extension into the spinal canal of a newgrowth in the thorax should not have been operated upon.

The above facts are stated, not with the object of explaining away the mortality rate of 10 per cent. in our operations for spinal cord tumors, but to show that the fatalities after these operations, if the cases are properly selected, should be no larger than 6 per cent. In the future still better results should be obtained.

BRACHIAL BIRTH PALSY: A PSEUDOPARALYSIS OF SHOULDER-JOINT ORIGIN.[1]

By T. Turner Thomas, M.D.,
PHILADELPHIA.

General Considerations.

In 1907 in an adult case of traumatic brachial paralysis with ankylosis of the shoulder-joint following an injury about a year and a half before, breaking up of the ankylosis under ether and the use of forced exercises by the patient resulted in about three months in the return of normal power to the whole limb which

[1] Read before the College of Physicians of Philadelphia, October 1, 1919.

has remained unimpaired since. This has been followed by many similar cases of varying grades of severity, in most of which forced exercises without a preliminary breaking up of the ankylosis under ether sufficed to restore the normal motion to the shoulder and power to the limb. The treatment was so simple and the paralysis usually so fleeting that records were kept of only a small number of special cases. In 1909, in a more severe type of traumatic brachial paralysis, with flail shoulder-joint in an adult, transferred to me at the Philadelphia General Hospital from the service of Dr. J. Chalmers Da Costa, by operation the normal shoulder-joint firmness was restored and by forced exercises the operative stiffness or ankylosis afterward removed. In about four months the patient had a normal arm and has had it since. I have now had 18 similar cases; 12 have been operated on. In 9 the paralysis disappeared and in 2 more it is disappearing. In one case death from lung involvement occurred too early to permit recovery from the paralysis. In 1910, in a boy, aged seven and a half years, with a brachial birth palsy, I found a hitherto undiscovered posterior shoulder subluxation of the same side. A complete paralysis at birth had practically disappeared, a considerable wrist-drop remaining, but the limb was much shortened and crippled from the persistence of the old shoulder-joint displacement. Operative reduction of the dislocation was not completely successful, but the wrist-drop was much improved as well as the function of the whole limb. This was the first time this operation had been done for this condition, but it has already become the prevailing operative treatment for it. I have now had 44 cases of brachial birth palsy and am satisfied that these as well as the above adult cases have been pseudopalsies, due to inclusion of the brachial nerves in an axillary inflammation, consequent upon an injured shoulder-joint and not true paralyses from injuries of the brachial plexus. Those interested will find a summarized discussion of this whole subject with the associated literature in the *Journal of the American Medical Association*, 1914, ii, 1018. It is not intended here to infer that the paralysis is not real and extensive and that the nerves are not involved, but merely that the paralysis is a pseudoparalysis in the sense that it is only temporary in the great majority of cases. An explanation of the temporary nerve involvement is offered, but even this is not insisted on. It is merely supported until somebody else offers a better explanation. What is insisted on, however, is that the primary and essential cause of the trouble in most cases is in the shoulder-joint, and that when that is removed early enough we need not be much concerned about the paralysis. That will then take care of itself. What we need most in the obstetrical cases is skilful attention to the shoulder at birth by the accoucheur, but we are probably a long way from this now.

It is manifestly impossible for this new and radical view to make headway without controversy against the universally accepted contrary theory, that of injury to the brachial plexus. The recent work of J. J. Thomas and J. W. Sever, in support of the plexus theory, directly challenges the shoulder-joint origin. They published the results of their work in three papers, all covering essentially the same ground, to which I shall refer when necessary, for the sake of brevity, as the orthopedic,[1] pediatric[2] and neurological[3] papers. The object of their work is seen in the following (pediatric): "Up to within a year or so most of us were reasonably content to accept the theory that the paralysis in these (obstetrical) cases was due to a stretching or tearing of some of the roots of the brachial plexus, due to a forcible separation of the head and shoulders during labor. Other theories have been discussed and have been given some credence, but recently a new one has appeared. It seems that it is about time for us to take account of stock and see which of these various ideas which have been advanced are reasonable and based on pathological findings and clinical facts." Their essential conclusion is as follows: "There is no evidence from our experimental work or clinical observations to support the theories of Lange and T. Turner Thomas that the primary cause of obstetrical paralysis lies in an injury of the capsule of the shoulder or dislocation, with secondary damage to the nerve trunks."[4] They admit that a few cases of shoulder-joint origin may simulate obstetrical paralyses, but claim that these are readily distinguishable.

When it was decided that I would assume the responsibility of opposing the then universally accepted plexus rupture theory and attempt to substitute a shoulder-joint origin, there was no reason to suspect it would soon be necessary to maintain priority for this view. In this connection it now becomes necessary to point out a certain confusion of facts, particularly in the papers signed by Sever alone. I am credited with only one paper, and this is given two dates of publication, 1913 and 1914. Lange's single paper is credited to 1912 and 1913. Notwithstanding these dates, Sever says: "T. T. Thomas has fallen back on the old Lange theory that the injury to the plexus is secondary to an injury to the joint capsule at birth and that the paralysis is due to an exudate which surrounds and compresses the plexus." In the neurological paper, signed by Thomas and Sever, I am credited with six papers and am here given credit for priority over Lange by two years, my first paper being dated 1910 (it was read in 1910) and Lange's 1912, and yet the following statement appears in this paper: "T.

[1] Sever: Am. Jour. Orthop. Surg., 1916, xiv, No. 8.
[2] Sever: Am. Jour. Dis. Child., 1916, xii, 541.
[3] Thomas and Sever: Jour. Nerv. and Ment. Dis., 1916, xliv, 289.
[4] Thomas and Sever: Jour. Am. Med. Assn., 1916, i, 206.

Turner Thomas was, perhaps, the first advocate of this theory in this country." I would state the facts as follows: The first mention in the literature of the shoulder-joint origin of traumatic brachial paralyses in adults and in children at birth and the first suggestion that the basic primary lesion was a laceration of the joint capsule appeared in my paper of the January, 1911, issue of the *Annals of Surgery*, while this is my sixth paper on the subject. Lange's first and only paper on obstetrical paralysis appeared in the latter part of June, 1912.

The few writers who have taken up the Klumpke,[5] lower arm, type of traumatic brachial paralysis in support of the Duchenne-Erb, upper arm, type have added to the difficulties in the solution of an already troublesome problem. There is distinct evidence that most of them have not studied Klumpke's paper. The general tendency has been to avoid this phase of the subject, and with good reason. Madame Klumpke did not report any personal experience with obstetrical paralysis, but referred to two cases reported by Seeligmüller. Her paper was based on one personal adult case of total, flaccid, brachial paralysis of motion and sensation together with a collection of similar cases from the literature. A sharp distinction should be made between this and the Duchenne-Erb type of paralysis. Klumpke saw the difference which must impress anyone who will study the two groups of cases. In the Duchenne-Erb there is essentially no disturbance of sensation, although all cords of the brachial plexus are mixed motor and sensory nerves; the paralysis of motion gradually disappears completely except occasionally for some atrophy and weakness, due to a severe restriction of motion at the shoulder-joint, sometimes at the elbow; and there is a practically constant but varying grade of such joint ankylosis. Klumpke's case was an adult and the cases she collected from the literature like it were adults. Note how the condition she found in her own case differs from that found in the Duchenne-Erb type: Sensation is completely and permanently lost except for some variation in its upper limiting border; the paralysis of motion is likewise complete and permanent; and there is no report of ankylosis at the shoulder. The Duchenne-Erb is a temporary or pseudoparalysis, the Klumpke a permanent or true paralysis. Klumpke's chief interest and study was in connection with oculomotor phenomena, particularly inequality of the pupils, and it was because of similar phenomena in Seeligmüller's two cases that she included them with her adult cases. Inequality of the pupils has not been reported often in connection with obstetrical paralysis and not with much positiveness and detail when it has been. I cannot say that it has attracted my attention in any of my cases. I have observed asymmetry of the face but have attrib-

[5] Rev. de méd., 1885, v, 591 and 739.

uted it to a sympathetic or associated atrophy on the side of the brachial paralysis. I have seen the same side of the chest much atrophied as well as the face.

The fact that in the great majority of obstetrical paralyses the paralysis gradually disappears until it cannot be recognized explains why reports of the condition in adults are so rare. I have never seen such a report, but I have seen two cases of rather a severe grade in adults. One was an orthopedic surgeon who very kindly called on me and gave me the privilege of examining the arm. He had a posterior subluxation of the shoulder-joint, a marked bending downward and forward of the acromion, which was shown well by the roentgen ray, and still had a considerable limitation of movement in this joint. He said the condition had been much more severe in his younger years, but there was at the time I saw him no evidence of paralysis. In addition to the absence of paralysis he furnished another good reason why we do not recognize the condition in adults. He could not afford to permit his present and prospective patients to know that he was crippled and unable to help himself. He added, also, that, so far as he knew, none of his patients or colleagues ever suspected the condition. The second case was a pupil nurse who seemed to have no trouble in performing her duties. She had no paralysis but had some atrophy from the limitation of movement at the shoulder.

Support for the Shoulder-joint Pathology. The temporary or pseudoparalysis, the practically constant preservation of sensation and the practically constant limitation of shoulder movement, which seems to be readily accounted for by the compression of the shoulder by the maternal pelvis during delivery, led me to suggest that the joint injury was primary and the paralysis secondary to it from inclusion of the branches of the brachial plexus in the axillary inflammation consequent upon the joint injury. A non-traumatic inflammation of the joint could produce a similar result. Since I never considered it justifiable to expose the nerves in any of my cases I have been compelled to offer the postmortem and operative evidence of others. Delbet and Cauchoix[6] collected 33 cases from the literature of brachial paralysis in adults following dislocation of the shoulder and added 2 of their own, in which the nerves were exposed at autopsy or operation, usually in the axilla. No rupture was found, but the nerves were embedded in cicatricial tissue, inflammatory tissue or bloody extravasation. Lange[7] exposed the axillary nerves in a case of obstetrical paralysis and found the cause of the paralysis to be the embedding of the nerves in dense connective tissue for an extent of about 4 cm. In 81 cases of obstetrical paralysis in which the brachial plexus was exposed,

[6] Rev. de chir., 1910, xxx, 673.
[7] München. med. Wchnschr., June, 1912, No. 26.

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Wyeth and Sharp[8] found that the "usual lesion was a dense connective-tissue formation choking the plexus and thus impairing its function." Most others who have operated on the plexus in obstetrical paralysis have interpreted these cicatricial conditions as being due to rupture of the brachial plexus. Ashhurst[9] says: "The descriptions of what has been found at operation soon after birth are so vague that not much reliance can be placed on such observations; this vagueness probably is due to the impossibility of telling, even with the nerves exposed to view, how much they were damaged. In cases operated on months or years after the injury occurred the extent of the scar tissue and the difficulty of the dissections render such observations also of limited value." Eversmann[10] reported the autopsy findings in a case two and half months after birth. The only lesion discovered was an induration, with thickening at the junction of the fifth and sixth cervical roots of the brachial plexus, for $\frac{1}{2}$ to $\frac{3}{4}$ cm. One could hardly accept these findings as proving a nerve rupture, although they have been widely quoted to prove such an injury.

Stransky[11] quotes Rouland as reporting an autopsy on a case of obstetrical paralysis which died on the tenth day. The nerve findings were negative. It is probable there is not a case of obstetrical paralysis on record in which a frank, recent rupture of any of the cords of the brachial plexus has been found at operation or autopsy. Probably the only case on record with an autopsy soon after birth showing evidence of injury is that of Danyau,[12] who did not find nerve rupture but bloody extravasation around the plexus. He regarded it as evidence of injury of the plexus by forceps, and most of the writers who have since quoted the case agreed with him. Seeligmüller,[13] who was contemporary with Danyau, Duchenne and Erb, and one of the most quoted writers on this subject, thought that the bloody extravasation came from injury of the surrounding tissue by the forceps. He quotes the findings by Fritsch in autopsies on children born by the breech of bloody extravasations under the skin and in the muscles. He believed with Fritsch that such blood could alone cause paralysis by pressure on the nerves, so that with the disappearance of the blood the paralysis would disappear. Fritsch found in one case two days after a difficult delivery of the head a 5 cm. wide hematoma near the lower end of the sternomastoid, the disappearance of which was followed by disappearance of a paralysis of the corresponding arm.

[8] Surg., Gynec. and Obst., 1917, xxiv, 34.
[9] Ann. Surg., 1917, lxviii, 25.
[10] Arch. f. Gynec., lxviii, p. 143.
[11] Centralbl. f. d. Grensgeb. d. Med. u. Chir., 1902, v.
[12] See Duchenne, l'Electrisation, 1872, pp. 353–357.
[13] Berl. klin. Wchnschr., 1874, p. 510.

SEVER'S CAPSULE INJECTIONS AND THE DUCHENNE-ERB THEORY. The suggestion that the paralysis is due to inclusion of some or all the branches of the brachial plexus in the axillary inflammation consequent upon a shoulder-joint injury is combated by Sever as follows (pediatric): He injected the shoulder-joint of several newborn infant cadavers with methylene-blue and then made an opening in the anterior part of the capsule of the joint to prove that the exudate following a dislocation or sprain of the shoulder-joint would not extend to the brachial plexus above the clavicle. In answer to this I would merely say that if the ecchymosis and exudate from a dislocation of the shoulder-joint, as not infrequently happens, extravasates to the elbow and hand, it will surely go a few inches above the joint to the brachial plexus, particularly in a newborn infant occupying generally the recumbent position. A discussion of the following quotation from Sever could be of very much importance, because it concerns the most vital part of the whole question. "This (the surrounding and invasion of the axillary nerves by the methylene-blue) would in life lead to a paralysis of the whole arm at and below the joint (shoulder), but would in no way affect the nerves above the clavicle, and in no case would there be the typical picture of obstetrical paralysis, *i. e.*, paralysis of the fifth and sixth cervical. As I have stated before, why the exudate should leave the nerves alone in immediate proximity of the capsule and seek out Erb's point, the junction of the fifth and sixth cervical segments, at least two or three inches above the clavicle, Lange and Thomas and others have not made quite clear." The emphasis here should be laid on the fact that Sever accepts without reserve the localization of the lesion at Erb's point. Such unreserved acceptance is very rare in the literature, today, although a few years ago it was almost universal. In a discussion of this subject with an eminent surgical friend in the spring of 1914, he said: "Am I to understand that you do not accept the C V and C VI (Erb) theory!" On my replying in the affirmative he said: "I am amazed! I did not think that anyone doubted that." So far as the literature shows, that was the attitude of probably the whole profession a short time before, but it (Erb theory) has lost a few supporters since.

The amazing thing is that so many writers have accepted and so few have proved it. What is this Duchenne-Erb idea and upon what kind of evidence does it rest? Duchenne,[14] in four infants a few weeks old, localized the paralysis by *electrical reactions* in every case, without exception, to the deltoid, biceps, brachialis anticus and infraspinatus. This was in 1872. Erb,[15] in 1874, in four adults, localized the paralysis by electrical reactions without

[14] Loc. cit.
[15] Naturhistorisch. medicin. Verein zu Heidelberg, 1874, No. 1, 130.

exception to the deltoid, brachialis anticus and biceps, usually to the supinator longus and sometimes to the supinator brevis, in one case to the supply of the median in the forearm and hand. In one case of obstetrical paralysis, two months old, he found that "The exact observation, which naturally gave considerable difficulty, showed that the deltoid, biceps, brachialis anticus (probably also the supinator longus), were completely paralyzed and that the infraspinatus was also probably paralyzed." Erb's particular contribution consisted in the fact that he localized the lesion to the junction of the fifth and sixth cervical roots of the plexus. We are confronted at once with the difficulty that the two differed in their localization of the paralysis, but this does not seem to have attracted particular attention. The most characteristic feature of the paralysis is the internal rotation. It is of interest that Duchenne accounted for the internal rotation from the shoulder down and Erb from the elbow down, Duchenne attributing it to paralysis of the infraspinatus and Erb to paralysis of the supinators of the forearm. Obviously the only way by which their work can be corroborated is by finding the same specially localized paralysis in the same way as they did—by *electrical examination*. There can be no substitute for this evidence. To what extent has this been done since the reports of Duchenne and Erb forty-seven and forty-five years ago? A satisfactory answer to this very important question would probably be impossible because of the very extensive literature that has accumulated and the difficulty of avoiding errors in searching it. Thomas and Sever collected the literature since 1902 and referred to that collected by Stransky up to that time, in this way covering the whole ground. All of this literature has been scanned with the purpose of finding cases in which the electrical reactions obtained by Duchenne and Erb were confirmed. While one hesitates to give the results because of the possibilities of error and the impossibility of gaining access to some papers, particularly to the theses, a strong suspicion was developed that no matter how careful the investigation very few such cases can be found. Gowers,[16] in 1888, in a clinical lecture referred to a case of obstetrical paralysis examined before the same class a few weeks before in which the electrical reactions characteristic of degeneration had been found in the deltoid, biceps and supinator longus. This is the closest corroboration of Duchenne and Erb that I succeeded in finding, and here there is no mention of the brachialis anticus which was included by Duchenne and Erb. Shoemaker[17] is one of the most quoted supporters of this theory. In the first of his two cases, in the first few days, the right arm hung in internal rotation, motionless except for slight extension and

[16] Lancet, April 14, 1888, p. 709.
[17] Ztschr. f. Geburtshilfe und Gynäk., 1899, xli, 33.

flexion of the fingers. In four to six weeks the power of the other muscles had so improved that a pure Duchenne paralysis had developed which was characterized by involvement of the supra- and infraspinatus, deltoid, biceps and supinators. His interpretation of a "pure" case is evidently open to question. Nor did he make any mention of the use of electricity. Of his second case he said "exact examination shows that the following muscles exhibit delayed development: supra- and infraspinatus, deltoid, biceps, triceps and supinators," surely not a pure case. He quotes Roulland (*Thèse de Paris*, 1887) as reporting a case spontaneously born with a typical Duchenne-Erb palsy (supra- and infraspinatus, deltoid, triceps and brachialis anticus). Here there is no reference to electrical reactions nor to palsy of the biceps, while the supraspinatus and triceps, not mentioned by Duchenne or Erb, are included in the paralysis. Hochsteter,[18] in 1893, reported a case in which "electrical examination by Goldscheider at the end of the third day showed no response of the nerves on both sides, to the constant or indirect current, on the other hand the arm muscles on the paralyzed as on the sound side were brought directly to contraction by both currents." These few cases represent merely a crude effort to turn light on a phase of this discussion that much needs it, and if it results in similar efforts by others it will have served its chief purpose. Unless someone else can do better than this we must assume that the findings of Duchenne in four cases and Erb in one case of obstetrical paralysis represent the only scientific evidence upon which the Duchenne-Erb etiology for this condition is resting today, *i. e.*, the originators of the theory have not been corroborated.

The number of cases reported has increased rapidly in the last few years, but those in which the electrical findings are reported still remain conspicuous by their absence. The failure to find such cases in the literature is strongly corroborated by the following: Fairbanks, in 1913, reported a personal experience of 40 cases, probably the largest up to that time, and supported the brachial plexus theory. He said that electrical examinations are not necessary before the end of the second month, the use of an anesthetic being essential; but by this time the case will probably show definite signs of recovery, so as to render electrical examination unnecessary. Thomas and Sever report a personal experience of 471 cases, by far the largest up to the present, and, perhaps, as large as that of all other writers put together. Sever says of these cases "electrical reactions have not been carried out, for this examination would mean anesthesia, which did not seem justifiable when one already had all the necessary data." We are looking now for corroboration of Duchenne and Erb, and we have here

[18] Berl. klin. Wchnschr., 1893, xxx, 1016.

what amounts practically to a confession that it is not obtainable. There is nothing in the articles of Duchenne and Erb to indicate that they found anesthesia necessary for their electrical examinations. Why should it be necessary for ours? Does this not indicate something radically wrong with their method of electrical examination or with ours? Of what value is it to us that Duchenne forty-seven years ago in four cases, and Erb, forty-five years ago in one case, found these electrical reactions if we cannot find them in any of our hundreds of cases today? It seems to me that those who accept the Duchenne-Erb theory carry a heavier responsibility than those who reject it.

If one may judge from the apparent lack of familiarity of most writers on the subject with the original articles of Duchenne and Erb and the difficulty I experienced in gaining access to them, very few have consulted them. This probably has had something to do with the widespread and unchanging faith that has grown up around them. There has been too much agreement with and dependence on what they found. Sever says that the results of his methylene-blue injections into the shoulder-joint indicated that in life we should have "a paralysis of the whole arm at and below the joint (shoulder)," but that we do have instead a localized paralysis of the Duchenne-Erb type. My experience has led me to the reverse opinion, that we do have the kind of paralysis suggested by Sever's experiments, soon after birth, and do not have the Duchenne-Erb localization, soon after birth or at any other time. I saw 5 cases within eight weeks after birth. One of the 5 had, at six weeks, made a rapid recovery and was moving all parts of the limb, although not normally. Later it made a complete recovery. Dr. L. C. Peter, a neurologist, saw the patient soon after birth and then found a complete paralysis except for slight movements of the fingers. In 1 case seen five days after birth there was not observed a single movement in the whole limb, not the slightest in any of the fingers, but occasionally the child would move the limb as a whole at the shoulder. In the other 4 cases there were very slight movements of the fingers, but of no other part of the limb. These findings are in perfect accord with the results of Sever's experiments.

Erb's Localization. Probably the most striking features of Erb's paper are its positiveness and the dogmatic character of it's clinical findings and conclusions, which allow little else to the reader than to accept or reject them. The result has been so one-sided that one will probably look in vain for any attempt at question concerning them. His localization of the lesion to the junction of the fifth and sixth cervical roots of the brachial plexus is based essentially on his findings by electrical examination in the four adult cases. His one obstetrical case was evidently employed to show that this special localization discovered by Duchenne in

his obstetrical cases was the same as in his (Erb's), adult cases, so that one wonders how the modern supporter of the Erb C V and C VI theory can accept this special localization for the obstetrical cases without accounting for the adult cases in present-day practice. For many years it was accepted for the adult cases, but one looks almost in vain today for any mention in text-books or the literature of this condition in adults. So far as it has been corroborated by electrical examinations in adults it has never had a strong position, according to my investigations. Taylor and Casamajor (*Annals of Surgery*, November, 1913, p. 577) reported 6 adult cases in connection with 4 of which very incomplete electrical reactions were given. They do not corroborate Erb's or Duchenne's findings. Remak[19] in 1877, Hoedemaker[20] in 1878–1879, Bernhardt[21] in 1882 and Nonne[22] in 1887 reported cases in which they found this specially localized paralysis of Erb by electrical examination, but the localization was far from being as precise as in Erb's original paper. It is of some interest to note that Remak was a pupil of Erb, that one of Hoedemaker's 2 cases occurred in the private practice of Erb and that Erb made the electrical examination in Nonne's one case. I found only one other adult case reported in which a similar paralysis was established by electrical examination, but the report was so brief and casual that one hesitates to use it as corroboration. In my opinion Erb's paper is open to at least one serious criticism. He localizes the lesion to the junction of the fifth and sixth cervical roots of the plexus. The fibers to many other than his paralyzed muscles pass through this junction, but he says that "In all four (adult) cases, without exception," the lesion involves the fibers to the same four or five muscles, all the other fibers escaping every time. Now in Case I he accounts for this particularly localized lesion by a traumatic neuritis of the brachial plexus from carrying a heavy load on the head. In Case II, he accounts for the same lesion by a "traumatic lesion of a part of the brachial plexus" from a fall down stairs on the outstretched left hand and simultaneously striking with the left shoulder against a wall. In Case III he accounts for it by a "neuritis of a certain portion of the brachial plexus" of unknown cause. In Case IV we are told that a cancerous involvement of the supraclavicular lymph nodes, the patient dying in a few weeks from carcinomatosis, produced pressure on the brachial plexus only at Erb's point. It does not seem to me that such a precise localization of the lesion would be accepted today on such evidence.

Every surgeon knows there is a large number of cases of weakness or palsy of the arm following injury of the shoulder, the

[19] Remak: Berl. klin. Wchnschr., 1877, xiv, 116.
[20] Arch. f. Psychiat. u. Nervenkrankh., 1878–9, ix, 738.
[21] Ztschr. f. klin. Med., 1882, iv, 415.
[22] Deut. Arch. f. klin. Med., 1887, xl, 62.

pathology of which has never been satisfactorily established. Some see them as paralyses, others only as stiff and painful shoulders of uncertain cause. It is generally understood that dislocations of the shoulder are frequently associated with the severe cases. It is very likely that the Duchenne-Erb type of paralysis resulted from one of the efforts to solve the problem involved. Schulz,[23] in 1908, reported a study of the late results in fifty-four uncomplicated dislocations of the shoulder and found varying grades of brachial palsy in 75 per cent. of them, and in most of the others there was some diminution of strength. He accounted for them by cicatricial contraction of the joint capsule and surrounding tissues. The outstanding fact in connection with these cases is that there was no nerve complication in any at the time of the dislocation. In the July number of *Surgery, Gynecology and Obstetrics* there is an abstract of a paper by Korteweg[24] on "The Results of Dislocation of the Shoulder and its After-treatment." He reviewed 845 cases. The abstract says: "For the diagnosis of a nerve paralysis the author demands the presence of disturbances of sensation and the complete or partial reaction of degeneration." We can only infer that "nerve paralysis" applies here to paralyses due to nerve injury and that Korteweg must have found some that were not in this class. I believe that his diagnostic rule will some day be applied to the obstetrical paralyses by the profession generally and that the Duchenne-Erb theory will fail to withstand the test.

Progress of Shoulder-joint Theory. Attention has already been called to the support which the pathology of a shoulder-joint injury in its etiological relationship to these cases has obtained in the literature. The theory of a shoulder origin has gained rapidly in the last few years, and it has had occasional support from the beginning. In his first article (1861) Duchenne attributed obstetrical paralysis chiefly to the associated posterior subluxation which he believed occurred at birth (see Fig. 1). Injury of the brachial plexus also contributed to the paralysis in his opinion. In his second article (1872) he reported 4 cases without dislocation in which he attributed the paralysis entirely to injury of the plexus. The profession afterward practically ignored the dislocations for many years, and during the last fifteen years, when they have been forced upon the attention of the profession again, the supporters of the plexus theory have accounted for them as a secondary development of the paralysis from the plexus injury. Erb, who reported only 1 case of obstetrical paralysis, thought careful examination would show the dislocations to be few in number. Seeligmüller says that these paralyses in the newborn are frequently complicated by fractures and dislocations and that these compli-

[23] Deutsch. Ztschr. f. Chir., 1908, lx, 333.
[24] Zentralbl. f. Chir., No. 46, p. 926.

cations have been completely overlooked in many cases. He saw 1 case with an undoubted dislocation of the humeral head into the infraspinous fossa. He says that Smellie (who was the first to report obstetrical paralysis in 1768) reported several cases of persisting arm paralysis, due to dislocation intrapartum. Dauchez[25] recognized "obstetrical pseudoparalysis," in which paralysis is simulated by a unilateral or bilateral dislocation of the upper extremity. Küstner,[26] in 1889, attracted much attention by his

FIG. 1

FIG. 2

FIG. 1.—Duchenne's illustration of his case of obstetrical paralysis with posterior subluxation of the shoulder-joint. The associated paralysis was attributed chiefly to the dislocation which was accounted for by the manipulations of the accoucheur at birth.

FIG. 2.—One of the author's cases with a severe degree of posterior subluxation of the shoulder-joint. The prominence of the humeral head is about as noticeable and there is the same internal rotation of the whole limb and flexion of the elbow, and almost the same prominence of the angle of the scapula, as in Duchenne's case (Fig. 1) The plexus theory supporters, today, say the dislocation is secondary to the paralysis from injury to the plexus.

contention that these obstetrical paralyses were due to injuries of the upper epiphysis of the humerus and the German surgeons who today find the same lesion are probably influenced by his work. The roentgen ray in those cases in which ossification has advanced far enough prove conclusively that the deformity is due to dislocation, not to displacement of a separated epiphysis. B. Sachs[27] said, in

[25] Ann. de Gynecol., 1891, xxxvi, 300.
[26] Handbuch der Geburtshilfe, p. 301.
[27] Jour. Nerv. and Ment. Dis., 1904, xxxi, 670.

1904: "If many cases were examined soon after birth there might be found a distinct subluxation of the head of the humerus, probably below the deltoid, which might possibly be identified with Erb's palsy; therefore, all cases of obstetrical palsy were not Erb's palsies." Whitman, in a personal communication in 1914, recognized in addition to the common cases with posterior luxations of the shoulder: (1) True congenital luxations of the shoulder (rare); (2) obstetrical luxations at birth usually with paralysis;

FIG. 3.—Obstetrical paralysis without dislocation, five days after birth. Not the slightest power in any of the muscles of the limb. Today, there is clearly power in all the muscles and the patient elevates the whole limb forward to the level of the shoulder.

(3) fractures of the humerus at birth at any point, rarely with displacement of the epiphysis of the head (may or may not be accompanied by paralysis); (4) in a large proportion of the ordinary cases of obstetrical paralysis there are evidences of injury of the shoulder of the nature of strains or sprains, as shown by sensitiveness to movement and pressure. Lange, in 1912, said that most of the obstetrical paralyses were due to lacerations of the capsule of the shoulder-joint. Platt,[28] in 1915, favored the plexus theory for

[28] British Med. Jour., May 8, 1915, p. 793.

most cases, a primary injury of the shoulder-joint or upper humeral epiphysis for some cases, but treated only the shoulder ankylosis which he found in all cases. Vulpius,[29] in 1914, ascribed these cases to epiphyseal injuries and found by exact examination that there was no real paralysis or, at least, it was not at all prominent. Gaugele,[30] in 1914, said that most cases were pseudopalsies, due to distortions of the shoulder-joint, with injuries of the capsule and other soft tissues and confined his treatment to the shoulder-joint. Peltesohn,[31] in 1914, said that most obstetrical paralyses are due not to injuries of the brachial plexus, but injuries of the upper humeral epiphysis. Van Neck,[32] in 1912, said that tears of the shoulder capsule and injuries of the upper epiphysis of the humerus simulate obstetrical paralysis. G. G. Davis,[33] in 1916, said that "there is primarily an injury of both nerves and articular structures." He also said: "The restriction of external rotation of the humerus is marked in these infants only a few weeks old," and that "The presence of restriction of movements a few weeks after birth is proof positive of periarthritic lesions." His treatment is confined to the restriction of movement at the shoulder-joint, the elbow-joint and forearm requiring attention in some cases. Ashhurst says: "All the muscles most constantly paralyzed are supplied by nerves which pass very close to the shoulder-joint, and, *ipso facto*, are liable to injury; whereas the muscles which habitually escape paralysis are supplied by nerves which at no part of their course come into close relation with the shoulder-joint or the bones which compose it. This seems to bring us very close to the theory of Thomas and Lange that the primary lesion is in the shoulder-joint and that involvement of the nerves occurs secondarily. It is indeed a question in my own mind whether this is not the most acceptable theory for the majority of cases."

Cadaver Experiments on the Brachial Plexus. In the last analysis the Duchenne-Erb theory must rest upon corroboration and the only kind of corroboration that will avail will be to find in our cases what they found in theirs, the proof of the definitely localized paralysis by electrical examinations. What are the other "necessary data" upon which Sever depended? That resting upon the interpretation months or years after birth of the adhesions and nerve thickenings found at operation or autopsy and the experimental data. The operative and postmortem evidence has been disposed of in the discussion of the pathology of the shoulder injury, and I would again refer particularly to the quotation from Ashhurst, with which I fully agree.

[29] Deutsch. med. Wchnschr., 1914, xl, 1053.
[30] Ztschr. f. Orthop. Chir., 1914, xxxiv, 511.
[31] Berl. klin. Wchnschr., 1914, li, 1162.
[32] Jour. de Brux., 1912, xvii, 117.
[33] Internat. Clinics, vol. iii, series 26.

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The experimental work has played a great part in supporting the Duchenne-Erb view. Fieux,[34] by lateral bending of the neck in the cadaver produced tearing of the roots of the brachial plexus most marked in those arising highest in the neck. He also produced a paralysis of the upper extremity in a rabbit by lateral bending of the neck. Shoemaker, after exposing the brachial plexus, like Fieux, in the cadaver of a newborn, prepared by alcohol, could not produce a tear of the plexus, but accepted the results and conclusions of Fieux for most of his cases. Taylor[35] made twenty dissections on ten infants within three to ten days after death. He found that tension was the only factor concerned in the production of the plexus lesion responsible for Erb's paralysis. By tension he produced a rupture at or about the junction of the fifth and sixth cervical roots of the plexus, in the twenty plexuses, *i. e.*, on both sides of the ten infants. He says "great force must be employed to cause the lesion." Sever's experiments consisted in applying traction and forcible separation of the head and shoulder in "numerous dissections on infantile cadavers." It is a little difficult to determine the results of the force applied, but one obtains the impression from his statements that with forcible separation of the head and shoulders, without lateral bending of the neck, the cords of the plexus could not be ruptured, but were made to "undergo dangerous tension and stand out like violin strings." He goes on to say that: "With the shoulder held and the head carried to one side, with the clavicle intact, considerable force was necessary to injure the plexus," and that "Even with considerable force the fifth and sixth nerves could not be completely torn across at Erb's point but frayed out inside the sheath, which always gave way first." With the clavicle removed it was easier to injure the plexus, but the clavicle is practically never broken in these cases, so that this experiment does not concern the problem at hand.

It is evident from the preceding experiments that much force is necessary for the production of a tear of the plexus by traction in the cadaver. In looking for a similar force during the delivery of a child we must keep in mind that forceps traction cannot be exerted on the brachial plexus because such traction can occur only after the head is delivered when the forceps are put aside. In most deliveries when the head is out the shoulders soon follow without much traction, often without any. Indeed, one will have no difficulty in finding cases in the literature of obstetrical paralysis developing after spontaneous birth. A case of this kind, reported by Roulland, has been mentioned on a preceding page. Labor was normal in 32 of the 471 cases reported by Thomas and

[34] Ann. de Gynec., xlvii, 52.
[35] Am. Jour. Med. Sc., October, 1905, p. 675.

Sever. In view of the results of the above experiments, particularly those of recent years, it is hardly conceivable that the mild lateral bending of the neck necessary for the delivery of an occasional obstructed shoulder will be sufficient to tear the brachial plexus.

I have tried the effect of direct extension on the head and lateral bending of the neck in six bodies of newborn infants, for which the following manipulations and results will be sufficiently representative to answer for all. Placing the body face downward approximately in the L O A position I applied the ordinary forceps (obstetrical) to the head, and while an assistant made counterextension on the shoulders, with my feet braced on the floor I pulled as hard as I could on the forceps—harder, I believe, than any competent physician ever pulled in a successful delivery. This was repeated two or three times. Then placing the right side of the neck on a suitable block of wood, with one hand on the head and the other on the shoulder, I bent the neck over the block with all of my force. This maneuver was repeated twice, after resting between tbe efforts. I then went through the same procedures on the opposite side of the neck. Dissection of the plexus on both sides showed no visible rupture at any point in either plexus. With the plexuses dissected clean of all traces of their sheaths the direct traction and the lateral bending on both sides were repeated with the same force as before while watching the plexus of each side in turn for any evidence of rupture, but none was detected. It may be well to bear in mind that as the traction is being applied to the neck and plexuses the continuations of the plexuses, the nerves, are surrounded by loose connective tissue and offer little resistance to the traction. If the dead nerves withstand such traction live ones are more likely to do so.

Treatment. The length of the preceding discussion concerning the etiology is worth while only if it leads to a more simple and effective method of treatment. Efficiency is the order of the day and obsolete ideas and methods are being ruthlessly set aside. One will have difficulty in showing any real progress in the treatment of these cases based upon the pathology of a plexus rupture. Lange spoke of it as the "let alone treatment." The rapidity with which the shoulder-joint treatment has been taken up by the profession since it was based upon a shoulder-joint origin of the condition, indicates that the theory of a brachial plexus origin is being rapidly set aside as surely as the same theory for the adult cases has long been obsolete. While practically all surgeons interested in the condition have adopted the shoulder-joint treatment the acceptance of the shoulder-joint origin has not been so general. Platt, perhaps, best expresses the mental attitude of most surgeons when he says: "As the treatment (of shoulder) is the same for all, the diagnostic disability (as to the seat of the causal lesion) is happily not of great

importance." As an indication of the rapidity and completeness with which the shoulder treatment is being recognized this is very satisfactory. But it is not enough because it is not all that the theory of a shoulder-joint origin offers. The shoulder-joint is injured at birth or it is not. If it is injured at birth that is the time to correct the damage, not many years afterward, nor many months or days. If there is no displacement in the joint, complete recovery will probably follow sooner or later, without special treatment; but if there is a displacement, and this is permitted to "heal in" for a few weeks, the chances are that nothing short of operation will restore the joint to the normal. If the correction is delayed a year the chances are that the normal joint relation cannot be restored even by operation. Sever says that the mere division of the sub-scapularis tendon is followed by the reduction of the dislocation. Much depends upon what we consider reduction. I have made persistent efforts at reduction in my earlier cases but with little success so far as actual change in the relations of the humerus and acromion are concerned. I am inclined to agree with G. G. Davis, that the good results of the operation are "due not to replacement of the head of the humerus but to the free division of restraining tissues and the placing of the parts in a better position."

We shall not obtain the best results, in my opinion, until we appreciate what went wrong at birth and make our efforts to correct it then. The only way in which this can be demonstrated is by the results in cases so treated. It is probably impossible to determine exactly what happens to the shoulder, but I believe one can obtain a crude but still effective conception of the mechanism of the shoulder injury from a close study of the typical deformity itself. In my judgment only one conceivable cause can account for this deformity, and this will account for every feature of it. The part of the child most liable to damage as it comes through the bony maternal pelvic ring is the widest part, at the shoulders. In rare instances Nature has not provided enough room, and one shoulder, probably the anterior, is jammed out of shape as it is passing under the pubic arch, temporarily or permanently according to the degree of compression. In either case there is a severe brachial paralysis from involvement of the axillary nerves in the consequent axillary inflammation, and the shoulder-joint soon becomes stiffened from the resulting cicatricial contraction. But the inflammation subsides and the cicatricial tissue is absorbed, so that the paralysis gradually disappears, the permanent crippling being due to permanent injury to the shoulder-joint. The elbow suffers often in less degree, but this phase of the subject is left out of the discussion now because it confuses the more important phase.

The shoulder deformity has always been the same in my cases except as to degree. It has three very important characteristics:

internal rotation of the humeral head and therefore of the whole limb, mild posterior displacement of the humeral head and bending downward over the head of the acromion antero-externally. The internal rotation is obvious, but the other two characteristics have not received attention until recent years because of their obscurity. They will probably continue to be overlooked in many cases. It may be almost impossible soon after birth to decide the question. There is one pathognomonic sign of the subluxation: On the normal side the upper end of the humerus projects a variable distance in front of the anterior edge of the acromion. On the side of the subluxation it cannot be felt from in front and by careful palpation with the finger the anterior edge of the acromion can be located a considerable distance below its normal level. On the normal side there is a hollow under the posterior border of the acromion; on the affected side, a prominence. The same pressure which forced the head backward bent the acromion down in front of it. It is this bent acromion in front of the humeral head that accounts for the permanency of such a mild subluxation, *i. e.*, permits the head to rest on the posterior glenoid margin without slipping back into the glenoid cavity. It is likely that the cases of obstetrical paralysis without subluxation are those in which the head was not pushed backward enough to allow the acromion to be bent down in front of it. The lesion common to both is the injury to other joint structures, particularly the capsular ligament. I have never seen a permanent palsy or crippling of the limb without a subluxation of the shoulder-joint, except in one in which there was some ankylosis and deformity of the elbow, and in that one the functional disturbance was very slight.

The only treatment that I have followed has been to restore the shoulder-joint to as near the normal as possible. Most physicians know something about the difficulties associated with old unreduced dislocations of the shoulder-joint in adults, so that it will not be necessary to emphasize the difficulty of restoring the shoulder-joint to the normal in these children in the presence of a long-standing subluxation, with the acromion and humeral head deformed by the original pressure and by later abnormal growth.

We are only beginning to appreciate the importance of this phase of the subject. To repair the damaged shoulder to the best effect is a large problem. My chief ambition is to be permitted to treat a case with dislocation within a day or two after birth. I have had such a case three weeks after birth, but that was too late for my purpose, as the cicatricial or healing process had been practically completed and reduction of the displacement by non-operative methods was impossible. I have seen two cases five days after birth, but there was no dislocation in either. One had a mild grade of paralysis which completely disappeared in a

few months. The other had a severe grade of paralysis, but this has been slowly disappearing, fast enough to satisfy the parents, and I still have it under observation. In all probability no case with a dislocation of the shoulder has ever recovered a normal arm, although with shoulder treatment they have been very much improved. According to my experience the improvement is largely in proportion to the degree of improvement obtained in the shoulder-joint. Manifestly the best time to correct the deformity there is when the displacement is recent, *i. e.*, at or very soon after birth. How to obtain the best results at this time is still an unexplored field.

Conclusions. 1. Obstetrical or brachial birth palsy represents only one phase of a much larger shoulder-joint problem. Almost if not all shoulder-joint injuries are associated with a brachial paralysis, palsy or weakness of varying degree and duration. Very rarely will an actual nerve rupture be associated with the paralysis.

2. The best evidence of the absence of such a nerve rupture is the almost uniform and gradual disappearance of the paralysis. This is easily proved in connection with the adult cases, and seems to be true of the obstetrical cases, in which the paralysis is usually of longer duration and more difficult to follow up. If the crippling of the limb persists into adult life it will probably be found in all cases that a posterior dislocation of the shoulder is associated, often with some moderate permanent disturbance in the elbow-joint.

3. In obstetrical paralysis soon after birth there is a profound and almost if not complete paralysis of the whole limb and not a paralysis limited to the small Duchenne-Erb group of muscles. This extensive paralysis is best explained by the inclusion of the branches of the brachial plexus in an axillary inflammation consequent upon a birth injury of the shoulder-joint.

5. The extravasation into the axilla of blood and synovial fluid causes an immediate inflammation and later cicatricial tissue, all of which is probably absorbed in time, thus accounting for the disappearance of the paralysis. Such a pathology has been well established by operative and postmortem findings in the obstetrical and adult cases.

6. The Duchenne-Erb localization of the paralysis by electrical reactions to the deltoid, biceps, brachialis anticus (Duchenne and Erb), infraspinatus (Duchenne) and supinators of the forearm (Erb) has been widely accepted but not corroborated.

7. In his first four cases Duchenne found posterior dislocation of the shoulder which he said occurred at birth and was chiefly responsible for the paralysis. He thought, however, that some of the paralysis was due to injury of the brachial plexus. In four later cases he did not find dislocation of the shoulder in any and attributed the paralysis entirely to injury of the brachial plexus. Since then practically nothing has been said of a shoulder-joint origin, the

dislocations passing unrecognized, and all cases being attributed to injury of the brachial plexus. Since 1911, when the shoulder-joint injury was offered as the primary cause, this theory has made rapid progress.

8. It is very likely that sufficient traction on the head at birth to rupture the brachial plexus has never been applied in a successful delivery.

SIXTH NERVE PARALYSIS OF OTITIC ORIGIN: GRADINEGO'S SYNDROME.[1]

By E. Hamilton White, B.A., M.D.,
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During the years of 1916 and 1917 I have had the opportunity of observing 2 cases illustrating this unusual complication of otitis. In the first case the appearance of the ocular paralysis caused considerable apprehension, as I was unfamiliar at the time with the type of case so fully described by Gradinego. The second case, coming a year later, after I had had an opportunity of familiarizing myself with Gradinego's paper, was very interesting, but did not cause the same anxiety on account of the favorable course which he has found usual in these cases. In presenting the two cases I have taken the opportunity of giving a synopsis of the original paper, which I feel will be of interest to any of the members who are not already familiar with it.

In 1904 Gradinego reported[2] a series of cases in which the three cardinal symptoms, suppurative otitis, severe pain referred to the side of the head, and paralysis of the sixth nerve, were present in combination. There were 5 cases of his own and others collected from literature.

The publication of his paper caused considerable discussion, and there was some doubt expressed as to whether the sixth nerve paralysis was really a complication of the otitis or a coincident symptom from some associated condition, such as suppuration of the sphenoid or an independent cranial nerve palsy.

In 1907 Gradinego[3] published a further paper on the subject and collected a series of 57 cases which illustrated his syndrome and established it as a definite clinical type. This syndrome he explains by the hypothesis of a localized meningitis from extension of the middle-ear suppuration through atypical pneumatic cells connected with the region of the Eustachian tube and extending more or less completely to the tip of the pyramid. These cells have been

[1] Presented at the Canadian Medical Association Meeting, Quebec, P. Q., June 26, 1919.

[2] Arch. f. Ohren., 1904.

[3] Ibid., 1907, vol. lxxiv.

described by various authors, but perhaps most beautifully demonstrated by Siebenmann, of Basel, by his corrosion method.[4]

Gradinego's work is of great interest as explaining the somewhat unusual complication of sixth nerve involvement by otitis and also as indicating a group of cases which, if neglected, may go on to a diffuse meningitis and death.

Reviewing the 57 cases he was able to classify them into three groups:

In the first group were 24 cases which showed a classical syndrome without other complicating features, beyond perhaps more or less inflammation of the mastoid. These cases ran a favorable course to complete healing and recovery.

In the second group there were 29 cases showing a typical syndrome but complicated by other lesions, such as seventh nerve paralysis, labyrinth irritation or optic neuritis, which he regarded as independent complications of the otitis rather than characteristic of the lesion by which he explains his syndrome.

In the third group were 4 cases which, in addition to showing the syndrome, later developed septic meningitis and died. He regards these as a more virulent type in which the process extends to diffuse meningitis; the second group illustrates an intermediate stage between the first and third.

The characteristic features of the syndrome are mentioned in detail:

Acute Suppurative Otitis. Usually the otitis in these cases is characterized by evidence of retention of pus in the middle ear, either complete or relative. This is indicated by absence of or insufficient perforation of the drum. In 32 cases in which details are given eighteen times there is no perforation, or there was late spontaneous perforation, or paracentesis was done late. The perforation was generally too small, so that it required subsequent paracentesis. Sometimes this was repeated as many as five times. It was also striking that the situation was frequently in the anterior half of the drum. Paracentesis, or enlargement of the perforation, was generally followed by a striking remission of the symptoms, pain and paralysis thus showing a definite relationship between the otitis and the paralysis of the sixth nerve. This remission of the paralysis after middle-ear drainage was well shown in my first case.

Severe Pain. Severe pain was referred to the temporal and parietal regions of the side involved. The otitis is characteristically accompanied by very severe pain, which, however, may subside a few days after the appearance of the discharge. This is referred to the deeper parts of the ear, or more characteristically, to the side of the head, occasionally to the retroörbital region. It is not characteristic of a fifth nerve neuralgia, which is paroxysmal, but is

[4] Anatomy of the Middle Ear, etc., Bardeleben's Handbook.

more intense and continuous and is little relieved by antineuralgic remedies. It sometimes appears two or three weeks after the discharge at the time of the appearance of the paralysis.

Paralysis of the Sixth Nerve. This symptom appears suddenly without warning, the patient sometimes complaining of a diplopia, and calls the attention of the physician to it. Paralysis does not usually appear early. In the 37 cases in which the exact appearance was noted: Three times it appeared early on the fifth to the tenth day; eight times it appeared from the fifteenth to the twentieth day; twenty times it appeared from the twentieth to the fiftieth day. Occasionally it is late; in 6 cases it was after the fifty-sixth day. It may be stated, in general terms, as occurring from three to six weeks after the beginning of the otitis. In the typical cases complete recovery usually occurs, but is liable to be slow. There are unusual cases in which the paralysis disappears rapidly, and to this type both of my cases belong.

The complicating symptoms of the second group were suggestive of a meningeal irritation.

Complications in the Mastoid. Complications in the mastoid were regarded as associated with a severe otitis, but having no direct bearing on the syndrome. In the 57 cases there were only 24 in which a mastoid operation was done; usually it was for the purpose of free drainage of the middle ear rather than for the relief of symptoms pointing to a mastoid involvement. The findings in the mastoid at operation were usually an inflamed mastoid without severe local disease, although in some cases there was mastoid abscess or even a perisinus abscess.

The seventh nerve paralysis, when present, was regarded as an independent manifestation, probably from involvement of the nerve in the region of the middle ear.

Certain features, such as the late appearance of the paralysis, are explained by the disease lying latent in the pneumatic cells of the pyramid, just as we often find foci remaining latent in the pneumatic cells of the mastoid and later setting up active trouble.

Other theories which have been advanced to explain the sixth nerve paralysis are found untenable.

It has been suggested that on account of the relations of the labyrinth to the ocular muscles it might arise in some way by labyrinth involvement. Characteristically, however, there is no involvement of the labyrinth in these cases.

It has also been suggested that we might have here an associated neuritis of the sixth nerve. The condition, however, occurs too constantly as part of the syndrome and the relation with the otitis is too definite for such an explanation.

In 2 cases there was a history of syphilis or a positive Wassermann reaction, but even in these the paralysis was quite uninfluenced by

antisyphilitic treatment, and the syphilis was regarded as an accidental finding, with no direct bearing on the symptoms.

The history of my own cases was as follows:

CASE I.—J. R., male, aged twenty-two years, consulted me on May 1, 1916, complaining of profuse discharge from the left ear.

Onset of Illness. Illness began two weeks ago, with very severe earache and headache, followed a few days later by discharge. The pain, however, was not relieved by the discharge and two days ago it was again very severe and accompanied by considerable fever.

Present Condition. On the examination the patient is a poorly nourished individual and looks ill, but shows no elevation of temperature. The left ear shows profuse mucopurulent discharge, which is pulsating. The drum membrane is injected and shows a perforation in the lower anterior part of fairly large size, suggesting chronic perforation. There is a slight fulness of the upper part of the drum and some slight swelling in the wall of the canal; there is no pain or mastoid tenderness.

The case was put on conservative treatment, frequent syringing with hot boric lotion, and for ten days there were no unusual symptoms. It must be stated, however, that the patient was of a rather sluggish mental type, and it is possible that pain might have been present without his complaining about it.

On May 10, about three weeks after the onset of the otitis, it was noted there was a paresis of the left external rectus. I referred the patient to Dr. McAuley for a report on the eyes, and his report stated that beyond a paresis of the left external rectus there was nothing abnormal to be made out. The fundus was normal.

The following day there seemed to be some increase in swelling in the canal and I decided to drain the mastoid. The outer table was very thick, the cells of the mastoid were small, filled with pus, but no marked destructive process in the bone. Following the operation there was a persistence of discharge from the canal, suggesting that the mastoid drainage had not been sufficient to relieve the suppuration of the middle ear. The condition improved for a day or so and the paralysis was less marked, but on May 23, probably from the obstruction of the aditus by granulations, the paresis became decidedly more marked and there was a slight elevation in temperature. As the right ear was normal I decided to perform a radical mastoid operation to ensure the complete drainage of the whole tympanum. This was done on May 25. The middle ear was full of pus and swollen folds of mucous membrane.

On May 27, two days after operation, there was a very striking improvement in the paresis, which gradually disappeared, and on June 9 it was reported absent. The ear healed rather slowly, but on July 3 he was discharged healed, though there was still some slight mucous discharge from the region of the Eustachian tube.

The case belongs, I think, to the first group described by Gradinego

and illustrates a favorable outcome to what looked at the time to be a case going on to an intracranial complication.

CASE II.—M. O., female, aged twenty-eight years, was seen on April 30, 1917. The history was that her right ear had been sore for five weeks and had been discharging since April 5, a little over three weeks. Pain at onset had been severe for over two weeks, when a paracentesis had been done, with a certain amount of relief. For the past two or three days the discharge had been profuse and the pain had reappeared.

On examination her general condition was somewhat below par, her temperature being 100°. The right ear showed a somewhat congested drum, with a bulging nipple-like perforation, indicating retention. On the following day she was operated on, a simple mastoid operation being carried out. The cells were filled with swollen mucosa, but there were no marked changes in the bone. A free paracentesis was carried out at the same time, and there was evidence of a certain amount of retention in the middle ear. The wound healed rapidly and the discharge from the ear stopped a day or so after the operation.

On the third or fourth day after operation (about six weeks from the onset of the otitis) she developed a paresis of the right external rectus, but as the ear condition gave every evidence of satisfactory healing, no further interference was carried out, and the paresis disappeared spontaneously in three or four days.

This last case is interesting as illustrating the development of the paresis after the middle-ear condition was on the high road to recovery.

A CLINICAL PATHOLOGICAL STUDY OF AN UNUSUAL SYPHILITIC MANIFESTATION RESEMBLING JUXTA-ARTICULAR NODULES.

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THE case which forms the material for the present study was seen more than a year ago, but the exigencies of the period delayed this report.

At the time this case was first seen an effort was made to find reference to a like condition in the available literature. Although mention of syphilis of the tendons was frequent enough, no study was found which compared with this case. We were led to believe

that we were dealing with a rare syphilitic manifestation which merited reporting.

CASE REPORT. The patient, R. R., was an American woman, aged twenty-nine years, and of more than average intelligence. She was born in New York and had never left the country. Her father had died of tetanus at forty-nine years; her mother of an unknown cause at forty-six years. The patient had three brothers and sisters alive and well. There had been one stillbirth among her mother's pregnancies, and one child which had weighed three pounds at birth died at thirteen days.

R. R. had married at eighteen years. She had one abortion at four months and did not become pregnant again. Her husband, who had always been well, died in a railroad accident, after two years of matrimony.

At twenty-two the patient married again. Although her husband is healthy, and they desire children, she has not become pregnant.

Except for a vaginal discharge after the abortion the patient had never been sick. She is certain that she has never had a disease of the skin or mucous membrane.

The presence of tumors on the extremities had been noted for about eight years. The first lesion was on the extensor surface of the left elbow and about the size of a pea. Additional masses have appeared since in an unnoted order, and usually were noticed accidentally. For instance, the mass on the knee was of appreciable size when first noticed four years ago. Until her present consultation the patient had never shown these lumps to a doctor and had not taken treatment.

Physical Examination. Patient is an adult white woman weighing 178 pounds. The hair of the head is profuse and well distributed. The shape of the head is normal. There is no mastoid tenderness nor discharge from the ears. The external ear presents no irregularities. The eyes are hypermetropic and require lenses. The pupils are central, equal and react to light and accommodation. The nose is negative. The tongue presents a superficial but nonfissured glossitis. The tonsils are enlarged and are slightly erythematous. The palate is highly arched, but with no suggestion of perforation. The teeth are all present and well preserved. There is no notching of the incisors.

The thyroid is not enlarged. There are no pulsations visible in the neck.

The lungs are resonant throughout.

The woman is rather fleshy and large mammæ overhang the area of heart dulness, so that the left border is rather difficult to determine. There is no enlargement to the right. There is no bulge over any part of the anterior chest wall. No cardiac impulses are seen. The heart rate is 82. The sounds are normal. The rate at the radial pulse is the same as the heart and of good quality.

There is no suggestion of the "water hammer" of Corrigan. The blood-pressure was not determined.

The smooth liver edge was felt under the costal arch. There were no masses felt in the abdomen. There was no tenderness elicited by pressure anywhere over the abdomen.

The skin and mucous membranes were free of any lesions or scars.

The patient was menstruating and no vaginal examination was made.

The contours of the extremities were normal, except for nodules at both elbows and over the left knee.

The nodules on the left elbow extend in a line from the olecranon process to the styloid process of the ulna. The first is situated two inches from the olecranon. It is semiglobular and about 3 by 2 cm. It lies entirely under the skin, which is freely movable over it. The tumor appears attached to or part of some subcutaneous structure, which limits motion of the mass except for about 1 cm. in any direction. To the touch the mass appears lobulated and made up of individual although connected masses. These are distinctly hard and cannot be indented by pressure over them. The skin over the lesion is not stretched nor is it red.

The second tumor on the left arm is about 2½ cm. distant from the first. It is 3 by 4 cm. It appears made up of only two connected lobules rather than many, and otherwise is of the same appearance.

No other masses are present on the left arm.

The lesions on the right arm are symmetrically arranged with those on the left. The masses are of the same character as those of the left arm.

Over the left knee and in the ligamentum patellæ, occupying the space of the normal indentation between the patella and the tubercle of the tibia, is a single mass about 2 by 2 cm., which gives the same resistance and is of the same structure as that described for the elbow tumor. The mass moved with the motion of the leg upon the thigh and gives no discomfort. There are no other lesions present on the legs.

The clinical diagnosis of multiple gummata of the tendons was ventured by both Dr. Young and myself. Blood for a Wassermann was taken and part of one of the nodules removed for section. The incision healed nicely.

The Wassermann was reported four plus positive to both alcoholic and cholesterinized antigens. (Laboratory of the New York Skin and Cancer Hospital.)

Radiographs taken by Dr. Young showed the nodules as outline of soft parts. No shadow of bone nor connection with bone was found.

The biopsy material was sectioned and stained.

Preparations with Levaditi silver impregnation were made and prolonged search for S. pallida proved unavailing.

Microscopically the tissue of the tendon was interspersed with larger and smaller accumulations of round cells. These aggregations were about the bloodvessels, which were unusually numerous and indicated that new bloodvessels and capillaries had formed in tendon, which is ordinarily almost free of bloodvessels. The type of cell predominating in the peri-arterial gummata was the round cell with occasional spindle-shaped epithelial cells. There were no giant cells nor polynuclears. There was no evidence of caseation nor necrosis. No cartilage nor bone had formed.

The bloodvessels were extremely numerous for tendon. The majority were of the single layer capillary form. The lumen of even the smallest was open and the lining appeared uninjured. No vessel was seen of sufficient size to show evidence of the infiltration of the coats.

There was no formation of a fibrous connective-tissue wall about the mass. It was apparently a diffuse process. The histopathological diagnosis was "granuloma, probably syphilitic."

We have considered that the patient received her syphilitic infection at the time of her first marriage. The early abortion and the subsequent barren period of eleven years is evidence in favor of this. The first appearance of this unusual lesion occurred three years after the syphilitic infection. Speculation as to the localization of the spirochetes, to which the gummatous process is the reaction, would be confined to the theory that in the period of spirochetocemia, spirochetes lodged locally in the infrequent end-capillaries of normal tendon. The impetus for the reaction to the presence of the organisms may have been some mild injury to the exposed sites of the elbows and knees. The fact that the patient knows of no eruption nor sore that would indicate syphilitic infection does not exclude her syphilitic infection. That the nodules did not ulcerate we believe to be due to the low plane of the metabolism of tendon.

At the time of the clinical examination the differential diagnosis presented little difficulty. Bursitis, ganglion, tophi, tendosynovitis and sesamoid bones were all easily overruled.

Recently the attention of one of us (G) has been drawn to the clinical resemblance between this described gumma lesion and juxta-articular nodules.

Juxta-articular nodules were first described by Jeanselme in 1899 among the Indo-Chinese. (To translate): "Clinically the nodules are of various sizes, globular or polyglobular, most often collected in masses. In the beginning the tumors lié deep in the subcutaneous tissue. Some of them are movable and roll under the fingers like ganglion; others appear adherent to the periosteum, from which they possibly originate. Later, these nodules become more superficial and are incorporated in the skin. Later still they raise from the surface as protuberances of very hard consistency. The skin undergoes no modification; it is only distended and perhaps dis-

colored at the highest point. The nodules are remarkably symmetrical. They occupy the external aspect of the extremities, surmounting by preference the bony prominences and grouping about joints. The points of predilection on the lower extremity are: the external malleolus; head of the tibia; tubercle of the tibia; anterior surface of the knee; trochanteric and sacrococcygic regions; on the upper extremity: the olecranon; epitrochlear; acromium; and dorsal surface of the digits."

The generally ascribed cause for the nodules is the result of the habit of the natives to lie with the elbows and knees in contact with the ground.

"On section studied with low magnification the nodules are divisible into three zones—an internal or zone of degeneration, an external or inflammatory and an intermediate or zone of transition.

"The degenerative zone is formed of irregular blocks, homogeneous and translucent, which stain a deep red with eosin. These blocks are fissured in all planes and their contours are convoluted. With higher magnification (ocul. I, obj. 6) the degenerative substance is subdivided into two portions; the first, really homogenecus, is a clear red; the second portion is more or less merged with the preceding and is vascular, slightly fibrillar and a violet red. In the spaces which separate the blocks into fragments are various ordinary polynuclears undergoing disintegration. The number of these leukocytes increases as one approaches the periphery of the degenerated mass. The leukocytes are situated in the large otherwise empty spaces which appear cut out by a punch in the dense fibrous tissue. At the borders of the large empty spaces are disseminated some smaller degenerative blocks, all easy to recognize, even the smallest, by the bright red color.

"The zone of inflammatory reaction is made up of two very different structures: one of fibrous tissue, the other of yellow meat like tissue. In the latter one finds: large and anastomosing fixed cells within a reticulum where the network is filled by criss-crossing fibrils in all planes; some fixed cells, freed in the form of macrophytes; some giant cells, with nuclei originating from connective tissue; innumerable plasma cells in the interstitial spaces; considerable number of polynuclears, most of the ordinary type, and some eosinophiles; and finally numberous blood and lymph capillaries, which consist of only one layer of flattened or raised epithelial cells.

"Between the frank inflammatory zone and that of sclerosis there exists some transitional forms. Little by little the collagen elements predominate over the cellular, the fibrils dispose themselves in thick bundles, separated by proper interstices, forming a mosaic of fixed flattened cells. Little by little the vessels become fewer and their walls thinner, and a compensatory diminution of the polynuclears exists.

"The zone of transition between that of degeneration and that of

inflammatory reaction is characterized by a gradual homogenization of the connective tissue which loses the fibrillar condition and stains deeply with eosin. Between the focus of necrosis and focus of the inflammatory area begins an eliminating sulcus which gradually causes the degenerative tissue to form as a foreign body within the fully sclerosed tissue.

"The bacteriological examination has been completely negative. In sections stained by Ziehl or Gram, or after treatment with 40 per cent. potassium hydroxide, we have never demonstrated any microbes.

"The microscopic examination has revealed nothing as to the nature of the nodule. They certainly do not reveal syphilis nor tuberculosis, nor any suggestion of xanthoma which have characteristic structures. The possibility of tophi naturally presents itself, but the site of the small tumors, their multiplicity, indolence, structure, absence of tophi of the ears, the rarity of pains and malformations about the joints, and finally the regimen of the class of poor affected are little in favor of such a supposition. The nodules are not fibroma, nor sclerosed forms of peri-articular bursæ."

It has been thought wise to give a rather full account from Jeanselme on juxta-articular nodules because of the scant attention paid to them in most of the English works, even those on tropical medicine. Were it not for the histology we believe it would have been difficult to differentiate the case of multiple gummata of the tendons from juxta-articular nodules.

SUMMARY. A case of multiple and symmetrical gummata of the tendons is described which clinically closely resembles the tumors of juxta-articular nodules. The microscopic picture is very different, however, and hence the two conditions cannot be confused.

Unfortunately we were not able to observe the effect of antisyphilitic treatment, but the suggestive history, positive Wassermann, and histology of one of the lesions puts the diagnosis of multiple syphilitic gummata of the tendons on a sound basis.

Thanks are extended to Dr. Elizabeth Finch for her aid in the technical study, and to the director of the Institute of Tropical Medicine and Hygiene, San Juan, Porto Rico.

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CONGENITAL ABSENCE OF ONE LUNG.

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Congenital absence of one lung is a rare condition. Twenty-one cases are reported in the literature. They are, briefly, as follows:

1. *Haberlein:*[1] Soldier, aged twenty years, who had respiratory difficulty. Absence of left lung. Left thoracic cavity filled with fluid. No left bronchus. Heart in normal position.

2. *Haberlein:*[1] Right lung absent in a soldier, aged twenty-four years. Left lung abnormally large. Right thoracic cavity filled with fluid. Both primary bronchi and all pulmonary vessels entered left lung.

3. *Bell:*[2] Young man, aged twenty-four years, a Pole, in the German service, who had had some respiratory difficulty since birth, died suddenly sitting up in bed. Right lung absent. Both primary bronchi entered the left lung. No right pulmonary vessels.

4. *Bell:*[2] Absence of left lung in young man; absence of left bronchus and left pulmonary vessels. Heart on the right side. Aorta small.

5. *Hein:*[3] Six weeks' old male child, very cyanotic. Right lung absent. Rudimentary right bronchus. No right pulmonary artery or veins. Ductus botalli wide open. Foramen ovale patent.

6. *Maschka:*[4] Premature child who lived two hours. Right thoracic cavity completely filled with pericardial sac and contents. Right lung absent. Right bronchus a pea-sized, closed pouch. Left lung single lobed. Absence of right pulmonary vessels. Esophagus ended blindly at about its middle point, but below communicated with the trachea.

7. *Stein:*[5] Six weeks' old child. Right lung missing. Rudimentary right bronchus. No right pulmonary vessels.

8. *Grüber:*[6] Stillborn child. Absence of right lung and right primary bronchus.

9. *Herrero:*[7] Man, between sixty-five and seventy years, found dead on the street. Left lung absent. No left primary bronchus. Right lung hypertrophied.

10. *Theremin:*[8] Girl, one hundred and twenty-seven days old. During life moist rales were heard in upper part of left chest and signs of pneumonia on the right side. Normal conformation of chest. At autopsy the left lung was found to be absent. Left thoracic cavity filled by pericardial sac; pericardium adherent to walls of thorax. Left primary bronchus represented as a pea-sized pouch.

No left pulmonary vessels. Left auricle received no vessels, but a single pulmonary vein emptied into the vena azygos.

11. *Theremin:*[8] Girl, eleven days old, died of pneumonia. During life, bronchial breathing on both sides posteriorly. No deformity of chest. At autopsy, left lung absent. Hemispherical cartilaginous pouch of left bronchus. No pulmonary veins entered the left auricle, but these united to form a large vessel which communicated with the vena azygos.

12. *Grüber:*[9] Premature child, born dead. Left lung absent. Chest symmetrical. Three short branches of the trachea at the hilus of the right lung. Left thoracic cavity filled with pericardial sac. Pulmonary artery divided into a right pulmonary artery and the ductus arteriosus.

13. *Tichomiroff:*[10] Girl, aged twenty-four years. Chest symmetrical. Absence of left lung and left primary bronchus. Three branches of right primary bronchus. One right pulmonary vein.

14. *Findlayson:*[11] Child, who lived few hours after birth. Right lung absent. Trachea ended in left bronchus. Left lung hypertrophied.

15. *Gross:*[12] Child, five months and twenty-three days old. Atresia ani. Asymmetry of face. Left lung absent. Right lung filled the right thoracic cavity and the small part of the left. Left primary bronchus ended 1 cm. long. Heart hypertrophied and filling left thoracic cavity. Right lung emphysematous. Left pulmonary vessels absent.

16. *Ellis:*[13] Boy, aged eight years, with diagnosis of acute articular rheumatism and acute endocarditis. Chest symmetrical. Physical examination: Expansion good but diminished on left. Dulness posteriorly to midaxillary line. Tubular breathing as far as midline on this side. Roentgen-ray diagnosis: effusion of left side of chest. Autopsy: Left lung absent. Right lung well beyond the costochondral line and twice the normal size. Large pericardial sac occupying remainder of left side of thorax. No left pulmonary artery or veins. Left bronchus 2.5 cm. long, ending as a blind pouch and covered with grayish tissue, which microscopically showed cellular-fibrous tissue, with ill-defined spaces lined by epithelium.

17. *Tebbutt:*[14] Boy, aged twelve years. Heart 15 cm. to the left of the sternum. Left side of thorax dull posteriorly. Presystolic and systolic murmurs at apex of heart. Roentgen-ray report: heart enlarged and pushed over to the left. Autopsy: Left lung absent. Left side of thorax occupied by the heart. Distended pericardial sac and pericardial adhesions. Pulmonary artery divided into two branches before entering the right lung. Pulmonary vein formed by junction of two main vessels, which themselves were formed by two or three smaller veins soon after leaving the right lung. Endocarditis of the mitral and aortic valves.

There are, in addition to these reports, four cases in the literature

where a possible rudimentary lung has been found covering an imperfectly developed primary bronchus.

18. *Miller:*[15] Male, aged four weeks. Left lung the size of a pea. Left primary bronchus small and capped by rudimentary lung.

19. *Miller:*[15] Male, aged six weeks. Left lung the size of a cherry, hanging on narrow bronchus.

20. *Miller:*[15] Female, two days old. Left lung a mass of tissue, 2 cm. long, attached to narrow bronchus.

21. *Hanson:*[16] Female child who lived fifteen minutes. Heart on the right side. Right lung smaller than normal. Left lung rudimentary and looked "like a bunch of millet-seed, not larger than buckshot, the left bronchus being simply a cord one-twelfth inch in length." Diaphragm absent on the left. Left thoracic cavity occupied by part of the small and the large intestines and the appendix just beneath the clavicle.

The cases of Bill, Flischmann, Meckel, Rivière, Pozzi, Sömmerling, Heyfelder, quoted by Förster (Missbildung) and by Fürst in Gerhardt's *Handbuch* are regarded as doubtful cases of congenital absence of one lung and have not been included in the above list.

Through the courtesy of the Department of Urology the writer has been enabled to report an additional case of congenital absence of one lung in a patient who was treated on the service for the urinary incontinence of tabes dorsalis. This is the first case of congenital absence of one lung in almost 6000 autopsies performed in the pathological department of the Johns Hopkins Hospital.

Clinical History. October, 1917.

H. S., aged forty-nine years; married. Family history negative. History of occasional slight dyspnea.

Patient had a sore on the penis at the age of eighteen (1888), which was apparently not followed by any secondary manifestations of lues. In 1912, he noticed that he had some difficulty in walking, particularly when walking toward the light, when he seemed to think that the ground was coming up to meet him. For one and a half years there had been nocturnal incontinence and some diurnal frequency. Examination at this time showed a positive Romberg and absent knee-jerks. On cystoscopy 300 c.c. residual urine was obtained. The bladder showed considerable trabeculation and cellule formation. The trigone was atrophied and the internal sphincter sufficiently dilated to make the verumontanum easily visible with the observation lens of the cystoscope. The diagnosis of tabes, with vesical involvement, was made.

In December, 1918, the patient returned to the clinic. For seven months he had been confined to his bed as a result of ataxia. His urinary incontinence had gotten worse, with constant dribbling day and night. From March to July, 1918, the patient had been catheterizing himself at irregular intervals. On May 23 he developed a right-sided epididymitis which subsided on incision and

drainage. In July, 1918, he developed epididymitis of the opposite side. Two sinuses discharging pus followed incision and drainage. In January and February, 1918, the patient received three intravenous and three intraspinous treatments for his tabes. He was under the care of Dr. E. L. Zimmermann, who reported a positive Wassermann of both the blood and the spinal fluid. The patient was admitted this time to the ward, following an incision of an abscess of the left epididymis.

Physical Examination. Showed a poorly developed, emaciated, middle-aged man, with atrophy of the muscles of both the upper and lower extremities, who walked with a typical tabetic gait; the thenar and hypothenar eminences of the hands were atrophied. He wore a urinal for incontinence.

Neurological Examination. Cranial nerves were negative. Pupils were equal but reacted sluggishly to light. The knee-jerks were present. Finger-finger and heel-tibia tests revealed marked incoordination. Romberg was positive. Movements of the big toe were not appreciated by the patient, showing definite loss of muscle sense. No ankle-clonus was present. Touch sensation was normal everywhere, but the patient was unable to distinguish between blunt and sharp sensations with the head or the point of a pin.

Head and Neck. Examinations were negative. No general glandular enlargement was present.

Thorax. Anteriorly the chest was asymmetrical and long. Retraction was present at both apices and in the interspaces. The left side of the chest was flatter than the right. Movement of the entire chest was restricted. Percussion note everywhere was impaired and flat at the apices. From the apices down to the second rib expiration was prolonged and suggestive of tubular breathing; everywhere else the breath sounds were bronchovesicular in character.

Posteriorly. Same asymmetry of chest existed, with marked bulging on the right. The spine showed convexity to the right in the cervical and thoracic regions. Vocal fremitus was diminished on the left and the percussion note was impaired over the entire left side and flat toward the base. On the right there was some impairment to percussion from the apex down to the angle of the scapula, otherwise the percussion note was normal on the right, with good descent of the lung on deep inspiration. On auscultation the breath sounds were tubular in quality in the region of the second and third thoracic spines on the right. The tubular quality stopped abruptly at the fourth thoracic spine. Below this the breath sounds were bronchovesicular. The breath sounds of the left side were suppressed, almost tubular in quality to the angle of the scapula, but vesicular below. At the left base showers of rales were heard at the end of inspiration.

Heart. Owing to the impairment of the percussion note on the left the relative cardiac dulness could not be made out. A diffuse pulsation was seen in the nipple line from the third to the fifth left interspace. Heart sounds were clear but distant in the aortic area. A soft, systolic murmur was heard in the region of the apex, but not transmitted to the axilla.

Abdomen. Examination was negative.

Genitalia. The penis was edematous. A discharging sinus communicated with the left globus major. The entire left side of the scrotum was indurated with scar formation and another discharging sinus was present at the lower pole. The epididymes on both sides were enlarged and nodular. The testicles could not be felt as separate masses from the epididymes.

Rectal. Numerous external hemorrhoids were present in a cauliflower arrangement. The anal sphincter was markedly relaxed. The left lobe of the prostate was of almost stony hardness. The right lobe of the prostate was small, flat and not indurated. The patient was discharged four days later, with the sinus of the left epididymis still draining.

On January 28, 1919, the patient received a Kollmann dilatation. This was immediately followed by an elevation in temperature to 105° F., accompanied by tachycardia, chills and profuse sweating. The patient was admitted at once to the ward.

The physical examination did not differ materially from that of his previous admission. The pupils were equal but reacted sluggishly to light. The knee-kicks were obtained, but with difficulty.

The thorax showed the asymmetrical character previously noted. There was a marked depression below the xiphoid and retraction at both apices. Vocal fremitus was diminished on the left. The percussion note was impaired at both apices while the breath sounds were bronchovesicular in type in front. On the left, posteriorly, vocal fremitus was absent and the percussion note was dull in character and flat at the base. On the right, posteriorly the percussion note seemed to be normal. Scattered over the entire chest in front and behind were numerous rales.

The maximum impulse of the heart was in the fifth interspace, almost in the axillary line. The left side of the scrotum was still indurated and a discharging sinus was present at the lower pole.

On admission the patient was in extreme shock. The temperature varied between 104° and 105° F. for the first two days. On the third day the temperature became subnormal and remained so until his death, six days later. While in the hospital the patient had marked rectal incontinence. He gradually grew weaker and had attacks of respiratory difficulty, accompanied by shortness of breath and rapid pulse. Two days before death signs of bronchopneumonia were found in both lungs. For four days before death the patient had complete anuria. The blood urea was 1.7 grams

per liter. The patient died on February 5, 1919. The actual causes of death were regarded to be bronchopneumonia and uremia.

No roentgen ray of the patient's chest had been taken during life.

Clinical Diagnosis. Tabes with urinary and rectal incontinence; chronic fibroid tuberculosis of the left lung; bilateral pyelonephritis, uremia; bronchopneumonia.

Autopsy Report. Anatomical Diagnosis. Syphilitic aortitis; fibrous orchitis, tabes dorsalis; abscess of left testis and seminal vesicle; pyelonephritis (bilateral); dilatation of colon; congenital absence of left lung, left bronchus, left pulmonary artery and left pulmonary veins; abnormal course of left innominate vein, lobular pneumonia, calcified lymph glands.

FIG. 1

The thorax was asymmetrical, the right half more prominent than the left. In the middle of the anterior part of the left scrotum there was a small fistula from which thick yellow pus exuded. The organs of the abdominal cavity were normal. On opening the thorax a very remarkable condition was found. The right lung was of tremendous

size, completely filling the right pleural cavity and extending medially over the front of the mediastinum and into the anterior part of the left hemithorax, so that the uppermost anterior margin of this lung came to lie at the left apical region, to which it adhered. From the left apical region the anterior margin of the right lung extended downward and lay about 10 cm. from the midline.

As may be seen from Fig. 1 the anterior portion of the thorax was occupied by a large part of the upper lobe and by the whole middle lobe. The right pleural space was empty and the pleural surface was smooth and glistening.

FIG. 2

The left lung was absent. The size and position of the right lung displaced the heart to the left and posteriorly into the position usually occupied by the lower part of the left lung. The lateral and posterior surfaces of the pericardium were adherent to the chest wall by firm connective tissue. No traces of visceral pleura were found. At the left apex there was a small portion of dark pigmented tissue, which was independent of any connection with the lungs or the heart.

On removing the organs of the neck, together with the heart and lung, the following remarkable condition was seen.

1. The trachea was large in diameter and descended down to the region of the bifurcation. At this point a large primary bronchus proceeded toward the right lung, where the usual ramification took place. The left primary bronchus was represented only as a small, blind pouch at the point of bifurcation. This condition may have represented an attempt toward the formation of a left bronchus at an early embryonic stage (Fig. 2, *a*).

2. The pulmonary artery arose from the left ventricle as usual, then passed under the arch of the aorta toward the right side and divided into three branches. Each of these entered the upper, middle and lower lobes of the right lung respectively. No left pulmonary artery.

3. The pulmonary veins were made up of: (*a*) Two branches which arose from the upper lobe and which united into one trunk. (*b*) One branch which arose from the middle lobe. (*c*) One branch which arose from the lower lobe. These three trunks emptied into the left auricle separately. No left pulmonary veins.

4. The superior vena cava emptied as usual into the right auricle, but received only one innominate vein. The left innominate vein emptied directly into the right auricle.

5. The right vagus and phrenic nerves had their normal relations. The left vagus descended normally. The left phrenic nerve coursed close to the chest wall, owing to the absence of the left lung.

Heart. The cavities were large and the muscles hypertrophied; heart valves smooth and glistening. The base of the aorta showed many sclerotic patches. This condition existed along the entire vessel.

Lung. The pleura was smooth but somewhat thickened. The upper lobe was large and consolidated posteriorly and laterally. The lower lobe was air-containing. The elastic structure of the lung appeared to be greatly increased. Over the left uppermost part of the middle lobe there was an area of atelectasis. Glands at the hilum were enlarged and some were caseous.

Spleen, Liver, Adrenals, Pancreas, Gastro-intestinal Tract. Normal.

Kidney. The left kidney weighed 160 gm. and was of firm consistency. The capsule stripped with difficulty, leaving a rough surface. The pelvis was distended by yellowish-white, thin, purulent material. Striations of the medulla were indistinct. The cortex was pale and granular. The ureter was of large calibre.

Right Kidney. Weighed 220 gm. Of the same gross appearance as the left kidney, but no fluid had accumulated in the pelvis.

Genitalia. Right testicle of firm consistency and the tubules did not pull out readily. Left testicle was represented by a cavity filled with pus. A large abscess was found in the left lateral lobe and a small abscess in the middle lobe of the prostate. The bladder showed nothing abnormal grossly.

Brain and Cord. The dorsal columns were gray and translucent. Brain showed nothing abnormal.

Microscopic Examinations. Right lung: Some alveoli were filled with a large number of polymorphonuclear cells and desquamated epithelial cells. Some contained red blood cells and large mononuclear wandering cells. Sections stained with Mallory's connective-tissue stain showed connective-tissue structure increased. Section through the small mass of tissue seen in the region of the left apex was formed of fat, connective tissue, bloodvessels and one small lymph node, in no way suggesting pulmonary tissue.

Aorta. Mononuclear infiltration around the bloodvessels of the adventitia. Some areas of necrosis of media.

Testes. Hyaline changes in many tubules. No signs of spermatogenesis. Tubules rigid and surrounded by thick walls.

Kidneys. Actual necrosis of the epithelial lining of some of the convoluted tubules. A few hyaline glomeruli. Some areas of mononuclear infiltration.

Cord. Section stained by Pal-Weigert method showed marked degeneration of the posterior columns. Section of liver, adrenals, intestines, pancreas and bladder were normal.

In these 22 cases absence of the left lung occurred fifteen times and of the right lung seven times, showing a definite predilection for this anomaly on the left side in the ratio of 2 to 1. No satisfactory anatomical explanation has been offered for this left-sided predominance, but interference with the blood supply in embryonic life is supposed to be in some way responsible for it.

Life is not incompatible with one lung. The period of life in 10 cases has varied from eight years in one to about seventy years in another, twelve dying before the age of one year. The analysis of these 10 cases as regards duration of life is as follows: 1 case of eight years, 1 case of eleven years, 1 case of twelve years, 1 case of twenty years, 3 cases of twenty-four years, 1 case of fifty years, 1 case of seventy years, 1 case of a young man.

Respiratory symptoms have not been common and the patients have often come to autopsy for other than pulmonary conditions.

There has been a tendency for the one lung to undergo compensatory hypertrophy and to occupy part of the opposite side of the thorax. Atrophy of the lung is reported in one case (Hanson's). The pulmonary vessels have shown abnormalities which are not constant for all cases. The primary bronchus corresponding to the missing lung has usually been rudimentary and has often ended as a blind pouch. The absent lung has most often been replaced by a large pericardial sac, sometimes by fluid, and in one case part of the small and large intestines was found occupying the left thoracic cavity.

In the cases previously reported the chest has been described as normal in contour. The thorax in the case reported here was definitely asymmetrical, the left side of the chest being flat and the

opposite side bulging, this asymmetry was more marked posteriorly. Chiladiti,[17] in 1910, diagnosed absence of the left lung from a roentgen-ray plate in a boy, aged ten years, who had a flattened left chest. It is possible that his case represents a true absence of one lung. But up to the present the clinical diagnosis of absence of a lung has never been verified at autopsy.

I desire to express my thanks to Dr. Carlos P. Chagas, of the pathological department, for having performed the autopsy and for having placed the literature on the subject at my disposal.

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SECONDARY MENINGITIS TREATED BY INTRASPINOUS ADMINISTRATION OF AUTOGENOUS SERUM. REPORT OF A CASE.

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During the last epidemic of influenza, some bronchopneumonia cases terminated in a fatal meningitis. These meningitides were reported to have been caused by pneumococci, various kinds of streptococci, and occasionally Bacillus influenzæ.

Two such postinfluenza meningitis cases occurred in my ward at U. S. A. General Hospital No. 12. The second one was treated successfully by the intraspinous administration of autogenous serum. This is the case I am reporting, not only because of the favorable outcome, but also in order to have others try out this therapy.

REPORT OF CASE. Patient, L. S., No. 963, a plumber, was admitted from Camp Polk, N. C., December 10, 1918, to U. S. A. General Hospital No. 12, Biltmore, N. C., in a seemingly moribund condition. A history was not taken at this time because of his irrational and stuporous mental condition. However, on January 4, 1919, the following facts were obtained:

Personal History. About one whisky a day. Smokes fifteen cigarettes per diem. Otherwise negative.

Family History. Father died of sepsis from a carbuncle. Mother, one sister and a brother all alive and well. No history of any hereditary diseases obtained.

Past History. Had trouble with his left ear two years ago and says he does not hear well in that ear. He never had measles, mumps, scarlet fever, diphtheria, smallpox, pneumonia, meningitis or malaria. He denies venereal diseases by name and symptoms.

Present Illness (taken January 4, 1919). Onset of the present illness on December 1, with "a heavy cold," when he "coughed night and day." Also had a high fever. He was told at Camp Polk that he had pneumonia. Was admitted to U. S. A. General Hospital No. 12 on December 10.

Physical Examination. General condition: A dyspneic, cyanotic, toxic, stuporous and moribund white male, aged twenty years.

Skin and mucous membranes: No eruption; face flushed and drawn; eyes and pharynx congested.

Glandular system: No general adenopathy. No thyroid enlargement.

Vascular system: Pulse slow, regular, of good force and collapsible.

Heart: Not enlarged. No adventitious sounds.

Lungs: Bronchopneumonia, bilateral, disseminated (physical signs will appear below).

Genito-urinary System: Faint trace of albumin. Occasional granular cast.

Abdomen: Flaccid.

Liver: Reaches from fourth intercostal space to costal margin.

Spleen: Not palpable. No tenderness. No masses.

Nervous System: Negative except for stupor, which at times slips into semicoma and at times changes to delirium.

Provisional Diagnosis. Bronchopneumonia, disseminated, bilateral, postinfluenzal. Sputum gave a questionable pneumococcus, type 2, precipitation test.

Progress. December 10. Conjunctivæ congested. Laryngitis present. Voice hoarse and husky. Signs of bronchitis in lungs. Too

ill to examine thoroughly. Blood-pressure 100/55. Telegram sent: recovery doubtful.

Dec. 11. Condition not improved. Patient delirious. Vomited dark-green fluid. Given intravenously 1000 c.c. of a 5 per cent. glucose solution. We are testing out convalescent influenza, bronchopneumonia donors, who had a type 2 pneumococcus sputum, for a transfusion tomorrow. Blood count: White blood cells, 38,000; polymorphonuclears, 94 per cent.

Dec. 12. Transfusion of 500 c.c. of a convalescent postinfluenza, bronchopneumonia donor given by the sodium-citrate method by Lieut. A. Orth. Blood culture sterile.

Dec. 13. Patient is decidedly improved. Temperature 102°, pulse, 76, respiration, 26; whereas on admission temperature was over 105°, pulse 105, respiration 38. Signs in lungs of a disseminated bronchitis. Although consolidation is not definitely found, it probably exists. (Sputum culture showed Gram-positive diplococci; pneumococcus agglutination test gave a questionable positive type 2 reaction.)

Dec. 14. Condition improved markedly. Temperature 100°, pulse 64, respiration 24. Signs in chest diminishing. Telegram: improving.

Dec. 15. Temperature rose again to 103°. Signs in lungs as they were. Complains of a headache.

Dec. 17. Signs in right lower lobe posteriorly extending as far as the axilla still marked, but no absolute or classical evidence of consolidation. Temperature vacillating. Still complains of a headache.

Dec. 18. Patient is again irrational at times. Cardiovascular system in good condition. Lungs: crepitant and coarse moist rales heard almost everywhere. No definite signs of consolidation, though it probably exists. Nervous system: headache, photophobia, stiff neck, slight bilateral Kernig. Right knee-jerk almost absent. Left knee-jerk diminished. No Babinski, Oppenheim or Gordon. No clonus. Considering the temperature and signs of central nervous system, meningitis is probable. Telegram: recovery still doubtful. Blood culture again sterile.

Dec. 19. Temperature still septic. Blood-pressure 132/78, whereas on admission it was 100/55. Patient appears a little better. Neck still stiff. Kernig doubtful. Knee-jerk diminished. Not as irrational as yesterday. No headache, no hyperesthesia, no photophobia.

Dec. 20. At right base, posteriorly, there is now dulness, higher pitched breathing and crepitant and fine moist rales.

Neck stiff. Headache. Kernig positive. Lumbar puncture should not be deferred any longer. In afternoon lumbar puncture done; 40 c.c. of turbid, cloudy, purulent fluid, under increased tension, obtained.

EXAMINATION OF SPINAL FLUIDS.

Date, 1919.	Cell counts.	Globulin.	Colloidal gold.	Cultures.	Films.	Mouse inoculations.	Sugar.	Appearance.
Dec. 20	61,400 Polys. 93 per cent.	4+	2, 2½, 2, 3, 4, 3, 3, 1, ± 0, 0	No growth	Many Gram-pos. diplococci, intra- and extracellular, resembling pneumococci	Fluid did not kill mouse	No reduction	Purulent.
Dec. 23	....	...	.....	No growth	.....	.....	.....	Purulent.
Dec. 25	31,800 per cmm.	...	.....	No growth	.....	.....	.....	Purulent.
Dec. 26	....	...	.....	No growth	.....	Withsediment of 20 c.c. of fluid did not kill mouse	.....	Purulent.
Dec. 27	415	...	.....	No growth	.....	.....	.....	Yellow, less cloudy.
Dec. 28	....	...	.....	No growth	Moderate number of pus cells and occasional gram + diplococci. No tuberculosis	No effect on mouse	.....	Clearer.
Dec. 30	600	...	.....	....	No bacteria found	.....	.....	Normal tension perceptibility clearer.
Jan. 1	300	...	.....	No growth	No bacteria; pus cells; occasional red blood cells	.....	.....	Clear yellow fluid.
Jan. 2	240	...	.....	No growth	.....	.....	.....	Clear yellow.
Jan. 6	20	±	.....	No growth	.....	.....	.....	Clear yellow.
Jan. 15	13	±	1½, 2, 2, 2½, 2, 1, 0, 0, 0, 0, 0	No growth	.....	.....	Reduction	Clear aqueous.

OTHER LABORATORY FINDINGS.

Blood cultures sterile Dec. 12, 18, 21 and 27.
Jan. 12. Pus from parotid duct = Staphylococcus aureus and Streptococcus viridans. Mouse did not die from broth inoculation of the latter.
Sputum: For type of pneumococcus; no definite agglutination. Not bile soluble.
Urine precipitation test for type pneumococcus, negative.
Wassermann, 1 plus.
Blood Counts—Dec. 10: White blood cells, 38,300; polynuclears, 94 per cent.
Dec. 20: White blood cells, 26,900; polynuclears, 90 per cent.
Jan. 4: White blood cells, 21,200; polynuclears, 66 per cent.

Spinal Fluid:
Cell count, 61,400.
Differential count: polymorphonuclears, 93; lymphocytes, 7.
Globulin, 4 plus.
Colloidal gold reaction.
Test-tube No. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 control.
Result: 2, 2½, 2, 3, 4, 3, 3, 1, ±, 0, 0.
Sugar reduction test, negative.
Culture, no growth.
Original film showed gram + diplococci, both resembling pneumococci, intracellular and extracellular.
Mouse inoculation, mouse remained alive.
Blood count: White blood cells, 26,900; polymorphonuclears, 90 per cent.

Dec. 21 (family present). Lumbar puncture done again this morning; 45 c.c. of cloudy fluid removed. Patient is apparently slightly improved. In afternoon lumbar puncture, 40 c.c. of cloudy fluid under less tension than that previously removed. Retinoscopy: Bilateral edematous papillitis (choked disk). Blood culture, sterile.

Dec. 22. Lumbar puncture done twice today.

Dec. 23. No headache. Neck not so stiff. In afternoon lumbar puncture done; 33 c.c. of cloudy fluid withdrawn. An autogenous serum for intraspinous treatment is being prepared. The patient evidently has immune bodies in his blood, for he is overcoming the pulmonic process. Culture of spinal fluid on blood agar, blood broth and serum broth negative.

Dec. 24. Left lung posteriorly, crepitant and moist rales. Right lung, lower lobe, is still consolidated. At 11 A.M. lumbar puncture. 40 c.c. of pus-laden fluid withdrawn. Injected 15 c.c. of autogenous serum. At 9 P.M. lumbar puncture repeated. 60 c.c. of less cloudy, yellowish fluid drained off. Injected 15 c.c. of autogenous serum.

Dec. 25. Lumbar puncture done twice today and autogenous serum injected. Examination of spinal fluid showed quantity 42 c.c., cell count 31,800, culture again negative.

Dec. 26. Lumbar puncture done and serum given twice today. Mouse inoculation twice with the sediment from 20 c.c. of spinal fluid did not kill the animal.

Dec. 27. Lumbar puncture repeated. 25 c.c. of autogenous serum administered. Spinal fluid is now yellowish from the serum and a little less cloudy perhaps. However, the general condition of the patient is worse. He is irrational. Blood culture again sterile.

Dec. 28. Although the temperature is persistently decreasing under the use of autogenous serum, the general condition of the patient is worse. He is now stuporous and irrational, but the vegetative organs seem to be holding up well. Mouse inoculation with the sediment of 30 c.c. of centrifugalized spinal fluid showed no effect on the mouse. Culture of the spinal fluid on blood agar and

blood broth sterile. Smear showed moderate number of pus cells and occasional Gram-positive diplococci. Smear for tuberculosis negative.

Dec. 29. Transfusion of 450 c.c. from a convalescent, post-influenzal, bronchopneumonia donor done by the sodium-citrate method. This was deemed necessary because the patient has been repeatedly bled in order to make up autogenous serum and because of the benefit of the last transfusion. Serum treatment twice today. Temperature has slowly declined until now it vacillates between 99° and 100°.

Dec. 30. Lumbar puncture. Spinal fluid: 600 cells per c.mm. Bacteria negative.

Dec. 31. Temperature normal. Patient appears less stuporous, but he is still irrational. Examination of left lung shows it almost clear and resonant. Lumbar puncture showed the fluid under normal tension and for the first time perceptibly clearer. It has, of course, a yellow hue from the serum. All in all the prognosis is more encouraging. Spinal fluid: cell count, 415 per c.mm.

Jan. 1. Patient is no longer irrational. Neck is not stiff. Kernig, however, still positive. Pupils dilated. Pulse: lower tension and dicrotic. Appetite very good. Lumbar puncture done and 25 c.c. of clear, yellowish fluid removed under normal tension. 20 c.c. of autogenous serum injected into the spinal canal. A clear fluid corroborated the clinical symptoms of marked improvement. Spinal fluid: 300 cells per c.mm. Smear: Bacteria negative, occasional pus cell. Few red blood cells. Culture negative.

Jan. 2. Lumbar puncture, 240 cells per c.mm. autogenous serum administered.

Jan. 3. Still delirious at times, but neck is no longer stiff. Kernig is still positive. Knee-jerk unequal. Lumbar puncture: Canal entered and blood was withdrawn twice. No serum given. Temperature under 100°.

Jan. 4. Neurological and mental status. Cranial nerves are normal. Somatic nerves: no anesthesia, no paralysis. Reflexes; pupils dilated; both react to accommodation. Right pupil reacts sluggishly and slightly to light; left reacts less sluggishly. Bicipital and tricipital reflexes normal. Pectoral, abdominal and cremasteric reflexes normal. Right knee-jerk absent. Left knee-jerk diminished. Neck still slightly stiff. Kernig sign still positive. Achilles and patella reflexes normal. No Babinski, Oppenheim or Gordon.

Perception: Fairly good but a little hazy. He recognizes and knows the use of common objects. He is oriented as to time fairly accurately, but is perfectly oriented as to place and person. No hallucinations exist. He does not dream.

Memory: He recalls well school days, date of enlistment and military life.

Emotionally stable.

Judgment and reason good. In case of fire he says he would wait for help. Were he able he says he would run with water-buckets to the fire. Lately he had been occasionally delirious. Only when delirious from pneumonia, pyrexia and meningitis did he show delusions and confusion. Then he talked about his wife, although he is single. However, he says he is now engaged.

Volition: Rather apathetic. Can feed himself, he says, but nurse does it for him. Involuntary defecation and micturition exists.

Attention: Is good.

Train of thought is coherent.

All in all, he is fast approaching normal mentality. The prognosis for a complete mental recovery is good. Blood count: white blood cells, 21,200. Polymorphonuclears, 66 per cent.

Jan. 5. Patient's temperature around 99°. He feels good. Pulse 100. Patient has bleeding hemorrhoids; a small indurated swelling is presenting itself below the mastoid process, just behind the right ear. Because the pulse has become more rapid, because the patient has been repeatedly bled for autogenous serum, and because of bleeding hemorrhoids and epistaxis from picking his nose, and because of the cervical infection, a blood transfusion of 500 c.c. was again done by the sodium-citrate method.

Jan. 6. Lumbar puncture done. 30 c.c. of rather clear fluid under increased tension removed. 22 c.c. of autogenous serum administered. Spinal fluid: 20 cells per c.mm. Globulin test: slight precipitate. Culture, negative.

Jan. 7. The swelling and inflammation of tissue below the right ear is more superficial and spreading. Urine: Pneumococcus precipitation test; no precipitation.

Jan. 8. Right ear-drum shows a prominent malleus with blood-vessels running down along it. Moreover, all around the margin of the drum vessels are migrating toward the center. Retinoscopy shows choked disk less severe than previously; also what appears to be an exudative retinitis.

Jan. 9. The swelling has grown larger and has spread and involves the whole parotid gland. It is red, hot, indurated and tender. There is no fluctuation. The temperature has risen, but this is due to the parotid inflammation, not the meningitis, which is practically cured. Eyes still staring. Kernig present. The hemorrhoids have bled considerably and he seems to pick at them.

Jan. 10. Swelling has now involved the whole right parotid. On gentle massage a bead of pearly pus presented at the orifice of Stenson's duct.

Jan. 11. Parotitis still the same. Temperature dropped. Kernig still present. Lungs seem clear.

Jan. 12. Parotid not so swollen nor so tender. Temperature is normal. Stenson's duct is still patent and a drop of yellow pus can

be pressed through the pouty orifice. Kernig sign is much less marked. Head not stiff. Mind is clear. Culture of pus from Stenson's duct showed a Pneumococcus-streptococcus viridans and a Staphylococcus aureus.

Jan. 13. Swelling of gland is decreasing. Pus can be expressed at will through the oral orifice.

Jan. 14. Parotid swelling decreasing, orifice less pouty and from it drains creamy pus.

Jan. 15. Parotid swelling nearly all gone. Pressure on the gland causes pus to be evacuated through the mouth.

Jan. 23. Lumbar puncture done. 25 c.c. of clear, aqueous solution withdrawn.

Spinal Fluid:

1. 13 cells per c.mm.
2. Globulin: plus-minus.
3. Colloidal gold reaction.

Test tubes Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 control.
Result: 1½, 2, 2, 2½, 2, 1, 0, 0, 0, 0.

4. Sugar, faint reduction.

Jan. 25. Patient feels fine. Appetite is splendid, Bowels regular. He is permitted to go to the bathroom. Temperature, normal.

Neck limber. Parotid swelling completely gone. Kernig negative. Right knee-jerk greatly diminished, only evident when reinforced. Left knee-jerk diminished to a lesser extent.

Retinoscopy: The papillitis and retinitis have disappeared. Fundi now appear normal.

The right ear-drum, which was hyperemic when the parotitis existed, has also returned to its normal appearance.

(These notes are taken verbatim from Clinical Record No. 963-1925, U. S. A. General Hospital No. 12.)

The subsequent notes are condensed and will show an uneventful recovery.

Jan. 31 to Feb. 4. Patient ran a low-grade afternoon temperature, evidently due to slight exertion.

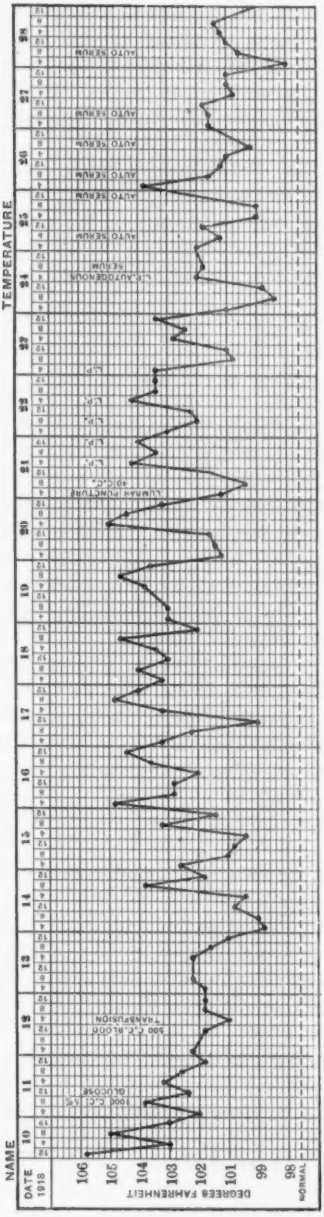
April 10. Neurological and mental examination negative.

April 29. Physical examination showed defective hearing in left ear. He may be discharged on certificate of disability. Meanwhile patient had been on graded exercises, as were all convalescent patients.

A note by a specialist said: Hearing, right ear, 9/20; left ear, 0/200.

Diagnosis: Partial deafness in left ear, probably of central origin and exaggerated as to degree.

DETAILS FOR PREPARATION AND ADMINISTRATION OF AUTOGENOUS SERUM. Aseptically insert a needle into the median basilic vein of the patient at the elbow and draw off blood into four


NAME
DATE 1915
TEMPERATURE
DEGREES FAHRENHEIT
NORMAL
106
105
104
103
102
101
99
98
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19
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23
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26
27
28
AUTO SERUM
500 C.C. BLOOD TRANSFUSION
1000 C.C. BLOOD
LUMBAR PUNCTURE
40 C.C.
L.P.
L.P.
L.P

50 c.c. centrifuge tubes. Separate the clot with a flamed platinum needle and centrifuge carefully at low velocity. After the serum is separated the tubes are kept in the ice-box. Centrifuging is not absolutely necessary if the serum separates easily. The spinal canal is tapped in the usual manner with the Quincke needle and spinal fluid is allowed to flow off slowly. About 30 to 60 c.c. of the turbid fluid is drawn off; the amount, of course, depends upon the spinal pressure and the clinical condition of the patient. The clear serum, which had previously been warmed to body temperature, is drawn into a 50 c.c. Luers syringe and injected into the spinal canal. Then the foot of the bed is raised.

Lumbar puncture and administration of serum should be done morning and night until the temperature drops. Then it should be done once a day; eventually on every second day and thus gradually decreased according to the clinical course of the disease and the laboratory examination of the spinal fluid.

Discussion. The rationale of autogenous serum therapy in secondary meningitis is evident for the following reasons:

1. Immune bodies exist in the serum in practically all infectious diseases.

2. This immune serum is brought into direct contact with the inflamed meninges and with the offending microörganisms.

3. Ordinarily the choroid plexus bars the free passage of immune bodies from the blood to the spinal fluid.

The principle suggested itself in this case because the patient was slowly overcoming the pneumonic process when the meningitis occurred. It was logical to suppose that he had immune bodies in his serum.

It is interesting to analyze this case more thoroughly and to evaluate the various procedures.

Upon admission the moribund pneumonic patient was literally revitalized by the timely use of three common therapeutic measures.

1. An infusion of 1000 c.c. of 5 per cent. of glucose solution which caused elimination by diuresis, increased cardiac function and had nutritional value.

2. Immune blood transfusion on the second day, which acted as a stimulant, and as a neutralizer of the toxemia.

3. Cardiac stimulation with caffein sodium benzoate, digitalin and camphor oil, alternatively, every six hours.

The patient, with the help of these therapeutic methods, was successfully combating the pneumonia; the temperature was stepping down; the leukocytosis was high; the whole clinical condition was improving remarkably when the meningitis started.

After the meningeal infection had gained headway, lumbar puncture *per se* was life-saving, because it relieved the otherwise fatal intracranial compression and because it drained the purulent toxic spinal fluid. Whether rachicentesis alone with the natural

and transfused immunity would have cured the meningitis, no one can say. The fact is that six days after the treatment with the intraspinous autogenous serum the temperature was normal. Although the patient seemed somewhat better just before the spinal treatment was instituted, we all know how misleading those apparent improvements in meningitis cases actually are; recurrences are the rule. Even from a hypercritical and conservative standpoint we can justly state the result is suggestive. It undoubtedly seems to have been beneficial in this case and may possibly aid in others. It cannot be denied that it is a very rational therapy and therefore should be tried in the absence of a specific immune serum of known value.

The unilateral suppurative parotitis was an unusual complication. The culture of the pus showed a Staphylococcus aureus and a Gram-positive diplococcus belonging to the Pneumococcus-streptococcus viridans group. This was probably not a hematogenous but an ascending duct infection, as four blood cultures were negative. The orifice of the duct was always patent and always drained pus until resolution occurred without surgical interference. No apparent parenchymatous destruction of the gland took place.

Three 500 c.c. transfusions were given. All the donors were convalescent influenza Bronchopneumonia patients. All were infected, as was this patient, at Camp Polk. The first transfusion was given to combat the pneumonia and the concomitant toxemia. The second was given to make up the blood withdrawn to prepare the autogenous serum. The third was given for the same reason and because blood was lost by epistaxis and bleeding hemorrhoids; then, too, it cut down the convalescence and may have helped the parotitis.

Laboratory Discussion. I have delayed publishing this article because I should have preferred to have had Capt. A. L. Garbat, M. D., New York City, chief of the laboratory, discuss this subject. However, he has been ill and hence unable to contribute his part.

It was unfortunate that no absolute conclusion could be reached as to the type of organism we were dealing with in the meningeal infection. The sputum gave a doubtful capital group 2 agglutination by the mouse method, but the organisms were not bile-soluble. The urine showed no precipitation tests. Repeated cultures from the turbid spinal fluid made on all types of plain blood or serum media remained sterile. Repeated animal inoculations with the sediment of the spinal fluid did not kill the mice, although stained specimens of the sediment showed definite Gram-positive diplococci both intra- and extracellular which had the morphology of pneumococci. Apparently the bacteria were dead. Smears from the pus of the parotid showed a similar organism, but these bacteria grew rapidly on artificial media, with the characteristics of a Streptococcus viridans. The cultures produced green pigment on blood agar, were bile-insoluble, were not agglutinated by pneumococcus serum and did not kill mice. Naturally one cannot draw any definite con-

clusions as to the nature of the meningeal infection from these findings. This does not, however, materially influence the point of importance which the author desired to bring out, namely, that it is wise in secondary meningitis to use intraspinally the autogenous serum, which probably contains a number of antibodies from the primary infection.

CONCLUSION. We recommend the use of autogenous serum injected into the subarachnoid space in cases of secondary meningitis when there is no efficient specific immune serum.

I must take this opportunity to thank Capt. A. L. Garbat, chief of the laboratory of U. S. A. General Hospital No. 12 for his ever-helpful coöperation. I also appreciate the assistance given by Sgt. P. Piel and his brother Pvt. R. Piel, of the laboratory force, who carefully made up the autogenous serum under our direction.

OBSERVATIONS ON THE COLLOIDAL GOLD REACTION WITH CEREBROSPINAL FLUID.

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DURING the past four years the colloidal gold test on cerebrospinal fluid as devised by Carl Lange has aroused great interest among physicians and laboratory workers. This reaction, the exact nature of which is not yet clearly understood, is proving of some practical value as a diagnostic procedure. The utility of the test is not generally recognized at the present time, and frequently the reaction yields information not obtained so quickly by any other diagnostic measure. This is seen particularly in the occasional case of meningitis in which the Wassermann reaction is negative and a characteristic curve is obtained by the colloidal gold method, or where a tuberculous curve is obtained and no acid-fast bacilli found; also in cases in which differential diagnosis between poliomyelitis and tuberculous meningitis is difficult the reaction has proved of value. As in all laboratory diagnostic procedures, however, occasional false reactions are obtained, and it is the chief object of this paper to record a few such instances and to make certain observations which may prove of interest to those performing the test.

Previous articles on the gold reaction have considered in great detail the methods of preparing the fluid, and we shall not discuss the subject except to say that if directions regarding cleanliness of glassware and purity of reagents are carefully adhered to no great

difficulty will be experienced in making the colloidal gold. Colloidal fluids will vary in their physical characteristics, and occasionally the same spinal fluid will give, with different colloidal gold solutions, a slightly variable curve, but the results are usually comparable. Nevertheless, it is advisable to use spinal fluid from known cases as a control to check the accuracy of each new lot of colloidal gold. Fluids that are opalescent yield a more marked curve than others, but although exaggerated the curve can usually be interpreted. Conversely, fluids having a clear red appearance and no trace of opalescence may yield but slight and inconclusive reactions. Such fluids are much more permanent than those possessing some degree of opalescence. In preparing the fluid it will be found that quantities of 500 c.c. or less are more readily prepared than larger amounts, and because of the ease of manipulation, this quantity is recommended or smaller quantities when few specimens are received.

NEGATIVE TESTS. In our experience the curves obtained in tuberculous and syphilitic meningitis and in tabes have been similar to those described by others. No correlation could be made between the degree of the curve and the extent of pathological involvement, but the fluid from patients with tuberculous meningitis gave an exceedingly pronounced curve when examined several days before death. In fact the reactions might be termed atypical, in that they tended to show the greatest change in the terminal tubes. Such fluids also showed a greatly increased cell count and positive globulin reaction, and the extent of the curve seemed to run parallel with the amount of globulin present estimated by the Noguchi butyric acid method. In a series of seventy-five fluids giving negative colloidal gold reactions only three showed a positive globulin test and increased cell count. They were as follows: one of syphilis, one of poliomyelitis and one of tuberculous meningitis. Thus the reaction failed in 4 per cent. of fluids that were obtained from known cases positive by other methods. In other instances of negative curve and positive globulin test, blood in greater or lesser quantity was found on microscopic examination. In the examination of the centrifugalized sediment it is highly important, in determining the presence of blood, to examine a fresh, unstained drop for very often in routine work the presence of a moderate number of erythrocytes is not demonstrated by the staining methods ordinarily used. The erythrocytes do not stain well or are washed off during the various manipulations. In our seventy-five negative fluids, which included a variety of conditions, there were three which gave positive Wassermann reactions and two others giving negative Wassermann tests, though the blood in both these cases yielded positive Wassermann reactions. These latter fluids reacted negatively by all other methods. The colloidal gold test, therefore, failed to react in 7 per cent. of positive cases.

SYPHILIS. Fairly constant reactions were obtained in syphilis, but there was great variation in the extent of the curves, and here, again, it appeared that the most marked reactions gave the strongest globulin tests. In a total of 122 luetic curves of varying degree there were obtained 95 giving changes that could be regarded as positive or highly suggestive of syphilis. Of these 62, or 70 per cent., gave positive Wassermann reactions, and of the remainder, 24 per cent., could be excluded as probably not syphilitic. There thus remained 6 per cent. of specimens when the colloidal gold test was positive and the Wassermann reaction negative. These cases were syphilis clinically. In 22 per cent. of the fluids the curves could not be interpreted, being either slight or else irregularly exaggerated. These figures would indicate that while the method appears to be more sensitive than the Wassermann test, there is much greater possibility of error in the absence of confirmation by other methods.

TUBERCULOSIS. Forty cerebrospinal fluids were received which gave positive colloidal gold curves and in which the tentative clinical diagnosis of tuberculous meningitis was made. Of these, 7 were subsequently excluded as not tuberculous. There thus remained 33 cases of tuberculous meningitis corroborated by other tests, guinea-pig inoculations or postmortem examinations. All these fluids yielded a negative Wassermann reaction, but had an increased cell content and globulin. Of the 33 known cases, 4 gave curves suggesting acute meningitis. Thus the reaction was correct in 88 per cent., and misleading in 12 per cent. The four fluids yielding acute curves were from terminal cases, and all showed a greatly increased cell count, strongly positive butyric acid test and tubercle bacilli in smears. Guinea-pigs were also positive for tuberculosis.

ACUTE MENINGITIS Fluids from 27 cases of acute meningitis were examined and 20, or 74 per cent., gave curves suggesting acute meningitis. Thus 26 per cent. were negative or inconclusive. In all these specimens the organisms were demonstrated in smears or cultures except one. In addition to the meningococcus there was 1 case of pneumococcus meningitis and 1 of Bacillus mucosus capsulatus infection. The latter reacted negatively. One fluid gave a curve in the luetic zone and 3 others were difficult to distinguish from tuberculous curves. The one fluid in which no organisms were found and which did not yield a characteristic curve showed a strongly positive globulin test, heavy sediment of polynuclear leukocytes and no reduction of Fehling's solution. This patient, a young woman of sixteen years, had been ill two weeks and subsequently became well without serum treatment.

Thus we find the reaction confirmatory in approximately 80 per cent. of cases. It apparently is most valuable in cerebrospinal syphilis, for many positive results are obtained when the complement-fixation reaction is negative. These results, however, unless confirmed by positive globulin tests and increased cell count,

should not form the basis for intraspinal or intravenous medication, but should lead to very careful observation of the patient and repeated examination of the fluid. In tuberculous meningitis the chief value of the reaction lies in the fact that a majority of these cases may quickly be distinguished from poliomyelitis in children and syphilis in adults. It thus also becomes valuable from a prognostic standpoint, but guinea-pig inoculation should not be neglected even in such instances. In acute meningitis the other changes are of much greater importance. It is rather interesting to note that in tuberculous meningitis when the exudate becomes very profuse the gold curve suggests acute meningitis. Differential diagnosis at this time would be difficult without the presence of organisms in smears. In poliomyelitis we found the curve inconstant, but more often in the luetic zone. In a number of instances in which the condition could not be differentiated clinically the curve was misleading. A few of the more interesting of these cases are cited below.

CASE I.—Mr. H. J., aged forty-two years. Chief symptoms: mental confusion; marked headache; retraction of head; bilateral optic neuritis; slight nystagmus, chiefly to left; reflexes weakened; evening temperature. The clinical diagnosis was meningitis. Four specimens of spinal fluid were received over a period of twenty three days, with the following results:

	Globulin.	Cell count.	Smears.		Wassermann	Colloidal gold.
1	Positive	...	Increased number of cells, few mononuclears and many polynuclears, few erythrocytes		Negative	0035554300
2	Positive	460	do.	do.	Negative	1543333210
3	Positive	360	do.	do.	Negative	0034543100
4	Positive	340	do.	do.	Negative	0014544333

No organisms were found in smears, cultures were sterile and guinea-pigs inoculated showed no evidence of tuberculosis. The patient died and the autopsy disclosed a subacute endocarditis involving the mitral valve and numerous infarctions of the brain. In this case the curves obtained were entirely misleading. At different times tuberculosis, syphilis and acute meningitis were suggested.

CASE II.—George K., aged two years. Clinical diagnosis: acute meningitis. The patient presented the usual symptoms of acute meningitis. The first spinal fluid received was very turbid; globulin strongly positive; cell count, 140. Wassermann negative. The sediment showed numerous small and large mononuclear cells, polynuclears and no organisms. The following gold curve was obtained: 0123344554. A similar result was obtained seventeen days later, but acid-fast bacilli were also found. The patient died and the autopsy disclosed tuberculous meningitis, with a very extensive exudate at the base of the brain. This, therefore, was a

case of tuberculous meningitis, but the colloidal gold curve suggested acute meningitis.

CASE III.—Miss B., aged seventeen years. Eight weeks after operation for middle-ear abscess the patient developed intense headache; increased reflexes; temperature 100° to 100.5° F.; photophobia. Five specimens of spinal fluid and one of blood examined over a period of one month gave negative Wassermann reactions. The globulin reactin was strongly positive and the sediments showed greatly increased numbers of lymphocytes. The colloidal gold reaction persistently suggested syphilis, giving curves of which the following is an example, 5544311100. Six guinea-pigs inoculated with different specimens of spinal fluid gave negative results. The patient died shortly after, but no autopsy could be obtained. The history and termination suggested cerebral abscess, but the colloidal gold test suggested tabes.

CASE IV.—Mrs. C. P., aged forty-four years. Clinical diagnosis not made. Syphilis suspected. Chief symptoms: headache; vomiting; inability to walk; exaggerated reflexes; weakness. Temperature, 97° F. "The Wassermann reaction was reported negative by two different laboratories." The cell count and globulin were increased and the colloidal gold reaction gave the following curve—2345542000—thus suggesting syphilis. About six weeks later the patient died. The history and physical signs in this case suggested cerebral tumor. No autopsy could be obtained.

CASE V.—The following data are of interest as an illustration of the effect of intraspinous medication. Mr. G., aged forty-five years. Primary lesion seventeen years previously. Symptoms at present suggest taboparesis.

Date.	Globulin.	Wassermann.	Cell count.	Colloidal gold.
June 9 . . .	Positive	++++	250	4555543100
22 . . .	Positive	++++	Greatly increased	2345554310
July 12 . . .	Positive	+++	25	0001222210
20 . . .	Positive	++	Slight increase	3333200000
Aug. 3 . . .	Negative	....	80	0000000000
Sept. 1 . . .	Weakly positive	++++	.....	3333300000
21 . . .	Positive	++++	Increased	1133331110
Nov. 17 . . .	Positive	+++		
Dec. 19 . . .	Weakly positive	++	Increased	1333331000

This patient received numerous intraspinous injections of salvarsanized serum and intramuscular injections of mercury salicylate. The treatment appeared to have but slight permanent action on the syphilitic process. It is interesting to note that the extent of the colloidal gold curves remained in keeping with the Wassermann reaction and the globulin test.

CASE VI.—Mr. T. H., aged forty years. Died, after several days' illness, with symptoms suggesting meningitis. At autopsy there was found acute pancreatitis and intense edema of the brain. The cerebrospinal fluid removed at autopsy gave the following curve—1134555552—thus suggesting acute meningitis. Otherwise the fluid was negative.

CASE VII.—T. N., aged three years. Symptoms of acute meningitis. The cerebrospinal fluid showed 1100 cells per cubic centimeter, strongly positive globulin test and negative Wassermann reaction. The sediment yielded greatly increased numbers of lymphocytes and polynuclear leukocytes; acid-fast bacilli present. The colloidal gold reaction performed, with two specimens of fluid collected on different days gave negative results. Guinea-pigs were positive for tuberculosis.

CASE VIII.—Miss C. E., aged twenty years. After preliminary malaise, anorexia, headache and mental dulness the patient rapidly developed symptoms of acute meningeal disturbance, with marked retraction of head, rigidity of spine, hyperflexion of legs and thighs in lateral decubitus and progressively increasing stupor. The pupils were immobile, but there was no definite strabismus. Clinical diagnosis: tuberculous meningitis.

The spinal fluid showed greatly increased number of lymphocytes, positive globulin reaction (double plus) and negative Wassermann. The colloidal gold curve suggested syphilis. Guinea-pigs reacted positively for tuberculosis.

CASE IX.—Miss N., aged twelve years. Complete paraplegia below the fourth cervical segment; slow onset; three months' duration. No sensory disturbances. Electrical reactions present. Cerebrospinal fluid under pressure, clear; cell count, ten; globulin strongly positive. Wassermann reaction negative. Colloidal gold curve 1223331100, suggesting syphilis. Clinical diagnosis: poliomyelitis.

CASE X.—Mr. E. C., aged thirty years. Influenza two weeks previously. Entered the hospital complaining of headache, vertigo and vomiting. Temperature, 97° F.; pulse, 50. Two days later he became restless and delirious. Axillary temperature, 100° F.; pulse, 120; slight retraction of head; twitching of arms and legs, especially on the left side. Respiration rapid and of Cheyne-Stokes type.

The cerebrospinal fluid removed just prior to the onset of the latter symptoms contained eight cells per cubic centimeter; globulin double plus; no reduction of Fehling's solution and a negative Wassermann reaction. Smears showed mononuclears chiefly. No organisms were found. The colloidal gold reaction gave the following curve—0133322100. The patient died and the autopsy disclosed a diffuse glioma involving the right parietal region.

BLOOD CONTAMINATION. Perhaps one of the most serious faults in the test lies in the fact that cerebrospinal fluids when contaminated with blood yield curves in the luetic zone, thus making interpretation very difficult. A relatively small quantity of blood serum appears to be sufficient to produce marked reactions. To determine precisely this effect, human serum in varying dilutions was tested with colloidal gold and found to yield curves in the luetic zone. The curves were most typical in a 1 to 1000 dilution, and this quantity of serum is sufficient to give a plus minus or a one plus globulin reaction. In routine work a large proportion of spinal fluids contain a trace of blood, and if not carefully guarded against, serious errors of interpretation may result. Human serum in very low dilution gives curves in the terminal or acute meningitic zone. Diluted luetic serum appears to give more pronounced curves than the non-luetic serum and inactivation does not greatly alter the curves. The following is an example of the gold solution reactions obtained with human serum:

Serum.	Globulin.	Colloidal gold.
Undiluted 0.2 c.c.	....	0001232222
1 to 100	++++	2223422020
1 to 1000	+	3443320000
1 to 10,000	0	1100000000

Although it is preferable to perform the reaction with fresh fluid, yet it was found that specimens kept several weeks at ice-box temperature yielded a characteristic but slightly diminished curve. The heating of fluids caused slight change in the curves even when the spinal fluid was heated to the boiling-point. The few observations made with contaminated fluids show that such specimens are unsuited for examination, for frequently reactions are obtained in the luetic zone when all other tests are negative.

CONCLUSIONS. 1. The colloidal gold reaction is useful as an additional or confirmatory test.

2. It is of greatest value in the syphilitic diseases of the central nervous system, especially tabes and paresis.

3. The test may serve to differentiate between tuberculous and other forms of meningitis.

4. The reaction is correct in approximately 80 per cent. of cases.

5. Cerebrospinal fluid contaminated with blood in small quantity frequently gives reactions in the luetic zone.

6. Positive results unconfirmed by other tests are of only slight value.

7. The Wassermann reaction and the cytological examination of the cerebrospinal fluid are of greater value than the colloidal gold test.

THE PREPARATION OF A STABLE VITAMINE PRODUCT AND ITS VALUE IN NUTRITION.*

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and

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Introductory. The view is no longer accepted that a diet of purified proteins, fats, carbohydrates and mineral salts in proper proportions is adequate for the needs of the body. In 1911, Funk[1] obtained from rice polishings and yeast a substance which he called "vitamine." This substance could prevent and cure beriberi, or its analogue polyneuritis, in birds, and was therefore called "antineuritic vitamine." Subsequently, Funk,[2] Hopkins,[3] and others showed that this vitamine, found in a variety of grains, vegetables and animal products when added to such a diet as the above makes it satisfactory for growth. Funk[4] expressed the view that there is besides the antineuritic vitamine a separate and distinct antiscorbutic vitamine distributed in fruits and vegetables and a specific antirachitic vitamine occurring in certain animal fats and oils.

Regarding the value in nutrition of the vitamines as they occur in the natural fresh foodstuffs, it has been demonstrated, time and again, of what vital importance they are to satisfactory maintenance and growth. However, owing to prevailing methods of food preparation, such as refining, heating, drying or canning, the activity of the vitamines is largely destroyed, with the result that continued ingestion of such food, even though eaten in sufficient quantities to satisfy the appetite, may ultimately lead to the various nutritional disturbances caused by a lack of vitamines in the diet. When one considers the minute amount in which vitamines are normally present in an adequate diet the extent of their nutritive value becomes the more remarkable.

It is known that disturbances in health may exist without arriving at the extreme stage when the appearance of a severe set of symptoms leads to the recognition of actual disease. This is particularly true of malnutrition which may arise irrespective of the quantity of food eaten. Malnutrition depends not upon

* Read before the Division of Biological Chemistry at the Fall meeting of the American Chemical Society, Philadelphia, Pa., September 5, 1919. We are indebted to Mr. H. A. Metz for the many facilities placed at our disposal during the course of this investigation.

insufficient food but upon improperly prepared foods or upon an improper combination of foods. The essential thing to recognize is that absence of vitamines from the food means disease and that a partial deficiency of vitamines leads to poor nutrition. Particular attention should likewise be paid to the diet of nursing mothers. Because of the inability of the body to synthesize its own vitamines, it is of prime necessity that the nursing mother shall partake of such a diet as will ensure an adequate supply of vitamines so that her milk will constitute a satisfactory food for the baby. If sufficient vitamines are not obtained in the usual diet then the deficiency must be supplied in some other way, as suggested by Voegtlin.[5]

Discussing the importance of vitamines in relation to nutrition in health and disease, Voegtlin[5] says: "It is of great importance that vitamine preparations should become available for the practising physician for the treatment of deficiency diseases. It is quite possible that a number of indefinite complaints and symptoms of adults and infants may be due to a partially deficient diet and would be benefited by the administration of vitamines. It is not always necessary that the full picture of a deficiency disease make its appearance. Such vague symptoms as loss of appetite and general weakness might very well, in some instances, be due to a deficient diet."

Proceeding from the above premises it was thought desirable to try to prepare a stable vitamine product that would prove effective therapeutically in increasing body growth whenever the nutritive powers of the individual were below par. After extended investigation we succeeded in preparing an active vitamine product, which we shall designate as vitamine preparation "V," the constitution of which we shall discuss in detail later on.

Experimenting with pigeons[6] we found that 1 gram of the vitamine product given every other day in addition to polished rice was sufficient (*a*) to prevent the onset of polyneuritis, (*b*) to cure polyneuritis and (*c*) to maintain and increase body weight. It subsequently developed that the amount of vitamine preparation fed to the pigeons was considerably greater than was actually required. Encouraged by these results we decided to determine the effect of feeding the vitamine preparation to children exhibiting a condition that could be attributed to a lack of vitamines in the diet. The cases available for study included children showing evidences of malnutrition, marasmus and rickets. We understand, of course, that the term "malnutrition" describes a symptom rather than a disease, but when no pathological reason exists to account for the malnutrition we may properly treat it as a dietary deficiency.

PLAN OF EXPERIMENT.

The experiment was divided into two parts: Part A, using four children, and Part B, using ten children. The babies selected were placed in separate cubicles under the constant supervision of day and night nurses. All food was carefully weighed or measured, so that the exact amount eaten was known. In addition to recording the weights of the babies every other day we ran a nitrogen, phosphorus and calcium balance, hoping thereby to note any possible deviation from the normal as a result of added vitamine ingestion.

Part A. This part of the experiment, which included the nitrogen, calcium and phosphorus balance, was divided into three periods: (I) Fore period of from nineteen to twenty-two days; (II) vitamine-feeding period of twenty-eight days, during which the children received 1 gram of the vitamine preparation daily in addition to their usual diet; (III) after a period of twenty-one days. After many trials a suitable method was devised whereby quantitative collections of urine and feces were made, the latter being marked off by carmin. Such collections were made during the last eight days, but three of Period I, the last six days of Period II and the last five days of Period III. Analyses were made by the usual well-known methods.

Part B. Here we have two periods: (I) Fore period of from ten to thirty-nine days and (II) vitamine-feeding period of forty days, during which five of the children received 1 gram of the vitamine preparation daily in addition to their usual diet, while the other five, receiving their diet only, acted as controls. During the last seven days of Period II, 2 grams of the vitamine preparation were given daily, and at times orange-juice was given, but nothing of particular import was observed as a result of this extra feeding.

It should be noted here that at the beginning of the fore period all these babies were given suitable formulas according to their needs. These formulas were changed from time to time in regard to their protein, fat and carbohydrate content when it appeared necessary, as shown in Table VII. Naturally during the fore period some of the babies thrived better than others. At the end of the fore period those babies which had done well were divided into two lots, and those babies which had not done so well were likewise divided into two lots. One lot of the "good" babies was combined with one lot of the "bad" babies, and the resulting lot of five babies (Lot V) was given the vitamine product in addition to the regular diet. The remaining lot of five babies (Lot C) received their usual diet only, and in this way acted as a basis of comparison for the first lot of children.

HISTORY OF PATIENTS.

Part A. Paul P. was admitted to the hospital November 22, 1918, aged fifteen months. He appeared to be very ill, was poorly developed, with flabby and wasted muscles. A diagnosis of marasmus was made and a suitable diet was prescribed. On January 15, 1919, the child weighed 14 pounds and its condition remained poor. On March 16 he was placed on a diet of bread, butter, milk, cereal and a mixture consisting of four eggs, 400 c.c. milk, 5 gm. sugar and 2 gm. common salt. The experiment began March 19; weight, 14 pounds; age, nineteen months.

William D. was admitted to the hospital February 26, 1919, aged thirteen months. He had an infection of the left hand and a discharge from the nose which persisted from the beginning of the experiment until March 29. The general condition of the child was poor, the muscles were flabby and he was poorly developed. A diagnosis of rickets was made. The child had been getting whole milk, and this diet was discontinued throughout the experiment, which began March 22, weight eleven pounds and 1 ounce, age, fourteen months.

Raffael De M. was admitted to the hospital November 12, 1918, aged six months. He had had chicken-pox and after recovery his general condition remained very poor, with evidences of extreme malnutrition. On January 1, 1919, he was placed on a formula of 30 ounces top milk, 8 ounces of 6 per cent. dextrinized barley gruel, 1.5 ounces lime water and 30 grains of sodium citrate. In addition to his formula he received a cereal and a milk and egg mixture consisting of 1 egg, 200 c.c. milk, 1 gm. salt and 2.5 gm. sugar. The child weighed 14 pounds and 3 ounces on January 7, 13 pounds and 1 ounce on February 28 and 11 pounds and 1 ounce on March 22, when the experiment began; age, 10.3 months.

Michael S. was admitted March 10, 1919, aged eighteen months. He appeared languid and his general condition was fair, while poorly developed. A diagnos s of acute pharyngitis and marasmus was made. On March 12 the child could not retain food, but very gradually his condition improved, so that by March 22 he was retaining all of his diet of bread, butter and milk and egg mixture similar to that of Paul P. On March 19, at the beginning of the experiment, the child weighed 14 pounds and 6 ounces; age 18.3 months. It will be noted that the caloric value of the diets of these children was at no time below the theoretical needs.

At the conclusion of the experiment all four children showed definite improvement, as a result of the addition of vitamines to their diet, while the last two showed such marked improvement that they could be classed as normal children in all respects.

Part B.—John C. was admitted to the hospital April 23, 1919, aged 2.75 months. His general condition was very poor and

his muscles were poorly developed; a diagnosis of marasmus was made. At the beginning of the experiment, June 14, the child weighed 7 pounds and 15 ounces; age, 4.5 months. At the end of the experiment a general improvement was noticed, his musculature and fat were fair, colon and abdomen were somewhat distended and moderate clinical anemia was noted.

Helen B. was admitted to the hospital March 24, 1919, aged six months. Her general condition and musculature were poor. A diagnosis of rickets, marasmus and chronic intestinal dyspepsia was made. Her weight at the beginning of the experiment was 9 pounds and 7 ounces; age, 8.25 months. At the end of the experiment the diagnosis was as follows: Musculature fair, fat fair, abdomen moderately distended, colon distended, digestion better as shown by the stool, and general condition much improved.

Annie de V. was admitted to the hospital January 29, 1919, aged 3.25 months. Her general condition was poor, with little fat and flabby muscles. A diagnosis of rickets, extreme malnutrition, marasmus and bronchitis was made. Her weight at the beginning of the experiment, June 4, was 8 pounds and 4 ounces; age, 7.5 months. At the end of the experiment, although the bronchitis still persisted, the general condition had markedly improved, with fair musculature and fat; abdomen and colon were moderately distended.

Walter McK. was born in the hospital September 11, 1918. He did not nurse well and was put on a formula. He appeared anemic, poorly developed and weighed 11 pounds and 9 ounces at the beginning of the experiment, June 1, when he was 8.66 months old. At the end of the experiment his condition had markedly improved, musculature and fat were good and there was no anemia apparent. He appeared normal in every way.

John P. was admitted to the hospital June 23, 1919, aged eleven months. A diagnosis of bronchitis, marasmus and chronic catarrhal enteritis was made, the general condition being poor. At the beginning of the experiment, July 1, he weighed 14 pounds and 11 ounces. At the end of the experiment the baby appeared very anemic and poorly nourished. A diagnosis of intestinal catarrh was made, it having been evident all along that we were dealing with a sick baby.

John R. was admitted to the hospital March 3, 1919, aged 1.5 months. His general condition was poor and his muscles were poorly developed. A diagnosis of malnutrition was made. The child weighed 9 pounds and 13 ounces at the beginning of the experiment, June 3, when he was 4.5 months old. At the end of the experiment his condition had improved, his musculature and fat were fair, while clinical anemia was observed.

John W. was admitted to the hospital November 15, 1918, aged one month. A diagnosis of gonorrheal ophthalmia was made.

His general condition was normal and he appeared to be well nourished. He weighed 11 pounds and 14 ounces at the beginning of the experiment, June 12, when he was eight months old. At the end of the experiment his musculature was good and fat was fair. His general condition was good, though showing clinical anemia.

Frank M. was admitted to the hospital November 4, 1918, aged fifteen days. He was a premature child. At the beginning of the experiment (June 14) his general condition was good and he weighed 11 pounds and 4 ounces; age, 7.75 months. At the end of the experiment his general condition, musculature and fat were fair.

Herbert W. was admitted to the hospital December 12, 1918, aged two months. The general condition was fair, with poor fat and musculature. A diagnosis of intestinal fermentation and malnutrition was made. At the beginning of the experiment (June 3) the weight was 9 pounds and 9 ounces; age, 7.75 months. At the end of the experiment his general condition was about the same as at the start.

William P. was admitted to the hospital June 23, 1919, aged eleven months. At the beginning of the experiment (June 25) he weighed fifteen pounds. His history is the same as that of his twin brother, John P.

DISCUSSION OF RESULTS.

Part A.—A study of the chemical findings in Tables I to IV reveals some interesting observations. In all cases there were only the faintest traces of calcium in the urine. In this connection Flamini[7] reported in normal children a calcium output of 0.125 gm. per day in terms of calcium oxide, having ingested 5.5 gm. daily; in rachitic children he found an excretion of 0.05 gm. daily, the intake being 3.4 gm. per day. In our cases the intake of calcium, expressed as oxide, varied between 0.49 gm. and 3.9 gm. daily, and yet no measurable urinary elimination was obtained. In Tables I and III it will be seen that the percentage retention of calcium was less in Period II than in Period I and less in Period III than in Period II. In Table II, a case of rickets, we note a progressive increase in the retention indicating a calcium hunger, as has already been observed in cases of rickets. In Table IV the percentage retention in Period II is increased by only 1 per cent., and then drops below that of Period I, similar to what has been recorded in Tables I and III. Obviously, as the experiment progressed, the need of the body for calcium, except in the case of rickets, became less urgent.

The daily elimination of phosphorus was very small, approximately one-fifth of the normal, on an intake varying from 0.36 gm. to 2.18 gm. per day. In three instances, Tables I to III, the percentage retention of phosphorus was less in Period II than in Period I

and less in Period III than in Period II. In the fourth case (Table IV) the percentage retention was greater in Period II than in Period I and less in Period III than in Period II.

Regarding the metabolism of nitrogen we have in every case, during certain periods, as shown in the tables, the apparent paradox of a retention of nitrogen accompanied by a loss in weight. A similar observation was made by one of us (H. E. D.), working with Schamberg, Kolmer, Ringer and Raiziss, in an investigation of psoriasis.[8] Observations of this kind were also reported as far back as 1860 by Bischoff and Voit,[9] and by Lüthje and Berger[10] experimenting with dogs. This retention of nitrogen without a corresponding gain in weight can be accounted for by assuming constantly changing water content of the tissues. Work done in Rubner's laboratory[11] has shown that in starvation the relative amounts of water in the tissues may increase quite markedly, at the same time that the relative amount of solid material decreases. While our children were not starving it is, nevertheless, obvious that in their state of extreme undernutrition there is a marked craving for nitrogen, and this craving was being satisfied, as evidenced by the nitrogen retention. It may be seen that all four children showed less retention in Period II than in Period I and still less in Period III than in Period II.

In general, therefore, there was a decreasing percentage retention of calcium, phosphorus and nitrogen, showing a gradual approach toward the normal. Whether or not these findings are directly due to the vitamine feeding we cannot say, although it is reasonable to assume that they are. It is quite possible that further detailed experimentation with vitamine feeding may yield definitely positive chemical findings, but for the present, at least, we must satisfy ourselves with the growth curve as the best evidence of vitamine therapy, and this brings us to an examination of the weight charts.

It is evident from Chart I that the children gained more weight during the vitamine-feeding period than in the fore period. In the after period two continued to gain weight while the remaining two lost 2 ounces each.

Looking at Table V we see that in the fore period of twenty-two days Paul P. gained only 3 ounces, in the vitamine period of twenty-eight days he gained 19 ounces and in the after period of twenty-one days he lost 2 ounces.

William D. in the fore period of nineteen days lost 5 ounces, in the vitamine period he gained 24 ounces and in the after period he lost 2 ounces.

Raffael De M. in the fore period of nineteen days gained 15 ounces, in the vitamine period he gained 62 ounces and in the after period he gained 12 ounces.

Michael S. in the fore period of nineteen days gained 18 ounces, in the vitamine period he gained 68 ounces and in the after period he gained 30 ounces.

It is not unlikely that if the first two children had received vitamine feeding over a longer period of time they would have done as well in the after period as the second two children. There is no doubt, however, that the rate of growth of all four children was greatly increased as a direct result of having received in their usual diet a daily feeding of the vitamine preparation.

Part B.—Having obtained such satisfactory results with these four children, we continued our experiment with ten more children, as already described, keeping a record of the weight changes only. The results obtained are recorded in Charts II and III and summarized in Table VI. At the end of the fore period Lot V received daily doses of vitamines in addition to their usual diet, while Lot C acted as controls.

Taking up Lot V, we see that John C. gained 5 ounces in the fore period of twenty-eight days and 21 ounces in the vitamine period of forty days.

Helen B. gained 9 ounces in the fore period of thirty-eight days and 20 ounces in the vitamine period.

Anna Da V. gained 10 ounces in the ten days fore period and 30 ounces in the vitamine period.

Walter McK. gained 11 ounces in the fore period of thirty-nine days and 48 ounces in the vitamine period.

John P. gained 1 ounce in the fore period of ten days and lost 18 ounces in the vitamine period. More will be said about this baby later.

In Lot C., John R. gained 8 ounces in the thirty-seven days fore period and 20 ounces in the forty days control period. It is, however, worthy of note that during the first ten days of the fore period this child lost 23 ounces while in the remaining twenty-seven days it gained 34 ounces as against only 20 ounces in the next forty days of the control period. In other words the rate of gain in the control period had fallen off considerably from what it had been in the immediately preceding twenty-seven days of the fore period.

John W. gained 3 ounces in the fore period of thirty days and only 7 ounces in the control period.

Frank M. gained 7 ounces in the fore period of twenty-eight days against 4 ounces in the control period.

Herbert W. gained 16 ounces in the fore period of thirty-eight days and only 4 ounces in the control period.

William P. gained 5 ounces in the fore period of sixteen days and lost 7 ounces in the control period. This baby and John P. of Lot V, are twin brothers, and were found to be suffering from intestinal catarrh. They may therefore be ruled out in the conclusions to be drawn from the results obtained.

It is quite clear in this part of the experiment, just as in Part A, that those children who received daily doses of the vitamine preparation in addition to their usual diet gained weight much more rapidly than those to whom vitamines were not given. At the end of the experiment

the general condition of the children who had received the vitamine product was somewhat better than that of the children who had acted as controls.

VITAMINES IN RELATION TO GROWTH.

Funk,[12] Harden and Zilva,[13] Drummond[14] and many other investigators have shown that growth takes place best when the diet includes the antiscorbutic, the antineuritic and the antirachitic vitamines, thus affording what might be termed a "*diet of sufficiency.*" It does not matter, from a practical point of view, whether we accept the above vitamine classification or the "fat-soluble A, water-soluble B" classification. Nor does it matter whether we call them "vitamines" or "food accessories," from a practical standpoint. The prime factor is that those substances of whose chemical composition we are still in the dark are admittedly necessary for proper growth.

Theoretically, however, we prefer the term "vitamine" to "food accessory," because a substance which is so vitally necessary for growth and for life itself can hardly be called an "accessory." Regarding the "fat-soluble A, water-soluble B, water-soluble C" classification of Drummond,[14] as opposed to the "antirachitic, antineuritic, antiscorbutic vitamines" classification, we believe that the latter is the more accurate. Drummond[15] supports the view that the antineuritic vitamine and the water-soluble growth accessory factor are either identical or else individually closely related members of the same class. While it is true that the antirachitic vitamine is found in certain fats and oils, it is also true that the supposedly "water-soluble B" may be dissolved in olive oil, as Myers[16] has demonstrated, and might therefore also be termed "fat-soluble."

The probability that antirachitic vitamine is either identical with "fat-soluble A" or has a somewhat similar distribution to "fat-soluble A" is discussed by Mellanby[17] in his paper "An Experimental Investigation on Rickets." Using dogs, he found that the animal fats were more antirachitic than the vegetable fats. The best of the vegetable fats are arachis (peanut) and olive oils; the worst of those examined include linseed, cottonseed, babassu oils, a hydrogenated fat and cocoanut oil. In other words the antirachitic substances for the most part were found to be similar to those in which, according to the experiments on growth of McCollum, Osborne and Mendel and others, "fat-soluble A" is present. From the results of his experiments, and a consideration of the growth experiments on rats, of other investigators, Mellanby concludes that, on the whole, the antirachitic vitamine and fat-soluble A appear to be identical. As to the relationship between the antineuritic and antiscorbutic vitamine, Harden and Zilva[18] and others have concluded that they are not identical, since substances showing marked antineuritic activity are antiscorbutically inactive, and *vice versa*.

McCollum's contention that scurvy is of intestinal origin has been disproved by many investigators. Givens, Hart, Hess, Mendel, Steenbock and their co-workers in this country and Chick, Hume and Skelton, Harden and Zilva and others in England have all substantiated the earlier view of Funk[4] that the disease is the result of a deficiency of some nutritive factor in the diet. In a recent personal communication to Chick,* McCollum has abandoned his early view on scurvy in favor of the generally accepted opinion that it is a "deficiency disease." We may therefore consider the antiscorbutic vitamine as distinct from the antirachitic vitamine associated with rickets and from the antineuritic vitamine associated with beriberi and polyneuritis. Hopkins[19] is likewise of the opinion that there are three distinctive vitamines, as just enumerated, and that each is concerned with a definite nutritional disturbance. *It may indeed ultimately develop that other nutritional disturbances or "deficiency diseases" are each associated with a distinct and separate vitamine.*

The relation of the vitamines to growth is again shown by the work of Kligler[20] in demonstrating that the growth of various pathogenic bacteria studied was favorably influenced by the addition of small amounts of watery extracts of various tissues; the ether extracts had no effect on growth; experiments are reported which indicate that the substance responsible for growth belongs to the class of so-called vitamines. This work is quoted merely to show the value of the watery extract as against the ether extract.

Another observation of a somewhat similar character is that of Emmet and Allen,[21] who found in experiments on the growth of tadpoles that too much fat in the diet was injurious to growth. The lack of vitamine obtained from yeast was more apparent than that obtained from fat, and in the absence of vitamines, growth and development were distinctly retarded.

Hess,[22] using liquid autolyzed yeast, found that it was an excellent stimulant to growth. It also exerted a favorable effect on the digestive processes as evidenced not only by a gain in weight and increased appetite, but also by the character of the stools. These findings are corroborated by ours in every particular, emphasizing the fact that the vitamine preparation retained the activity of the fresh autolyzed yeast.

Drummond[23] noted that an increase in food intake could be brought about by adding flavoring extracts, such as meat extract, to the diet, but unless the additions contain vitamine no growth results. Such facts make it apparent that vitamines are more than mere "appetizers," and that any increase in appetite would be more likely due to the improved condition of the individual, owing to the presence of vitamine in the diet. The results of our experiments lead us to believe that the water-soluble or antineuritic vitamine,

* Jour. Biol. Chem., 1919, xxxix, 204.

as we prefer to call it, supplies some essential factor which makes growth possible, since a mere increase in appetite does not result in an increase in weight if the added food is not properly assimilated.

Bearing upon the supply of antineuritic vitamine in the diet of the infant, an editorial in the *Journal of the American Medical Association*[24] says: "As Osborne and Mendel point out, the practice of reënforcing the supply of calories by diluting top milk and adding lactose leads to difficulties. Here the child is supplied with a food that contains a relatively smaller proportion of the water-soluble vitamine than does the original cow's milk. While this may contain enough vitamine as long as the intake is normal, if for any reason the child's appetite fails, the vitamine supply is reduced and various dietary troubles may easily result. This vitamine is of particular importance beyond the earlier stages of development, when to a scanty allowance of milk are added various foods poor in vitamines, thus giving rise to disorders."

Funk[12] and also Drummond[15] have shown that satisfactory growth has been secured with antineuritic vitamine in the absence of antirachitic vitamine, but the reverse is not true, which shows that the antineuritic vitamine is of greater importance than the antirachitic. Deprivation of the latter is not felt as soon as removal of the former, since in its own fat stores the body possesses a supply of the antirachitic vitamine, which it appears able to call upon when necessary. Funk[4 12] is of the opinion that the antineuritic vitamine is the only vitamine concerned with actual growth, while the antirachitic and antiscorbutic vitamines are specific for rickets and scurvy. This conception seems to be borne out by the numerous experiments of Mellanby, McCollum, Hess, Drummond and others, which show that in the absence of antineuritic vitamine proper growth does not take place even though the antirachitic and antiscorbutic vitamines are present.

On the other hand, Hess[22] showed that scurvy may develop, accompanied by an increase of weight. Likewise, Mellanby[17] demonstrated that rickets develops most easily in the fastest growing dogs. Both the scurvy and rickets could be cured by the administration of the respective vitamines, but no growth would occur unless the antineuritic vitamine was present in the diet. *We are therefore led to the inevitable conclusion that while the antineuritic vitamine is most important for growth, special care should be taken to see that the needs of the body for the three known vitamines are supplied, in order that adequate growth and general well-being may be obtained.**

In a recent paper Drummond[25] shows that although the fat-

* In a late publication (Am. Jour. Dis. Children), abstracted in this issue, Daniels, Byfield and Loughlin demonstrate that antineuritic vitamine added to the diet of babies supplied with food furnishing an adequate number of colories stimulates growth. This corroborates our findings and supports us in our assertion that the antineuritic vitamine is the one chiefly concerned with growth, although all of the three known vitamines are essential to complete growth and general well-being.

soluble or antirachitic vitamine is not strictly a growth factor, it is necessary for the maintenance of health in the adult rat. It is also necessary for the female rat during pregnancy and lactation. The absence of this factor brings about a lowering of resistance to diseases of bacterial origin, and consequently great care must be taken to ensure that dietaries of adults contain an adequate supply of this vitamine.

The statement just made takes on added significance in the light of the recently reported experiments of Bulley,[26] which tend to show that "xerophthalmia," an infection of the eye, is not a "deficiency disease," as has been held by McCollum, Simmonds and Pitz,[27] who said, "xerophthalmia and polyneuritis are abundantly demonstrated to have their origin in the lack of a sufficient amount of the fat-soluble A and water-soluble B growth accessory factors respectively." It may not be amiss to give in some detail the observations of Bulley,[26] and we shall do so as nearly as possible in her own words:

"That eye symptoms in rats may occur as a result of deficiencies in the diet seems to be a common experience. It is very important, however, to distinguish between symptoms due directly to a specific dietetic error and any that may be due to infection, encouraged, it may be, by diminished resistance due to the diet. My own experience seems to point to the fact that so far as xerophthalmia is concerned the latter relation is the true one. Since January, 1918, to date, 500 young rats were kept on various experimental diets. About half of the animals received fat-soluble A in the diet while the other half were given diets in which fat-soluble A was either absent or deficient. The basal diet consisted of extracted caseinogen, unextracted starch, sugar and salts. The stock animals from which the experimental animals were taken were fed on bread, milk, oats and various vegetables. To all the diets there was added a fat-free alcoholic extract of a yeast preparation.

"*Of all the animals used only five showed xerophthalmia.* Two occurred on a diet containing fat-soluble A to a limited extent; 1, where fat-soluble A was present in presumably sufficient quantities; 1 on an ample stock diet; and 1, where fat-soluble A was probably absent. Each experiment lasted three or four months, and in each experiment there were at least eight other animals on the respective diets, showing no symptoms of xerophthalmia at all. On this evidence, xerophthalmia would appear to have no direct relation to diet, since these 5 cases were on different types of food and to have little relation to growth.

"These results are attributed to the fact that (*a*) no trouble has been spared to keep the animals under the very cleanest and healthiest conditions, and (*b*) care has always been taken to treat very promptly with boracic lotion all cases of slightly sore-looking eyes. Regarding the clearing up of symptoms of xerophthalmia observed by others on giving fat-soluble A it is likely that as in so

many cases of obstinate infection general improvement of health brings about a cure of local condition. With avoidance of initial infection animals can be kept almost entirely free of this so-called "deficiency disease" whether fat-soluble A be present or absent. It is dangerous to draw conclusions as to the presence or absence of fat-soluble A in any diet merely from the appearance of xerophthalmia."

Funk[12] has obtained eye symptoms in rats even while their diet contained butter. These symptoms could be cleared up by washing the eyes with zinc sulphate solution, and also by adding antineuritic vitamine to the diet. This would seem to indicate that the sore eye condition is due to poor nutrition and not to a dietary deficiency.

It is evident from the foregoing statements that doubt is cast upon the belief that xerophthalmia is, in the true sense, a deficiency disease, so that the original classification of Funk[4] still holds good, at least as regards beriberi, scurvy and rickets.

Hart[28] and his co-workers showed that milk sterilized at 120° C. for ten minutes, commercial unsweetened condensed milk and commercial milk powder (Merrel-Soule) had lost their antiscorbutic properties when used in quantities equivalent to an amount of raw milk which would prevent scurvy in guinea-pigs on a diet of rolled oats and dried hay. The growth-promoting properties, however, are unaffected by the drying of milk. This emphasizes the importance of the use of some antiscorbutic in conjunction with infant-feeding. Hess[29] advocates the use of antiscorbutics in infant-feeding even as early as at the end of the first month of life. Orange-juice or lemon-juice may be used, but some stable antiscorbutic should be available for clinical use in view of the irregularity with which the various natural antiscorbutic products come into the market and the uncertain prices. Similarly, vegetable margarine should not be used exclusively because of the necessity of antirachitic vitamine in teeth-formation. Hume and Skeleton[30] show that a diet containing the antirachitic vitamine, as in butter, allows the development of sound teeth in puppies. In this connection Fisher[31] points out that delayed teething is undoubtedly due to insufficient phosphorus and vitamines in the food.

In concluding this brief discussion we would suggest that the "antirachitic, antineuritic and antiscorbutic" classification of the vitamines be used as being best descriptive of the three definitely established "deficiency diseases"—rickets, beriberi and scurvy.

PREPARATION OF THE VITAMINE PRODUCT.

The vitamine product "V" is prepared from corn, autolyzed yeast and orange-juice, thereby assuring the presence of antineuritic, antirachitic and antiscorbutic vitamines. The final product is dried

in vacuo at a low temperature, thus avoiding the destruction of the vitamines, particularly the antiscorbutic, which is the most unstable. In this connection, Harden and Robinson[32] report that by drying orange-juice *in vacuo* at 40° C. it is possible to obtain a solid residue possessing, in a high degree, the antiscorbutic property of the fresh juice. This value is not appreciably diminished when the substance is kept in a dry atmosphere at room temperature for six months. The stability of the antineuritic and antirachitic vitamines has been amply demonstrated by Funk,[1] McCollum and Davis,[33] Osborne and Mendel[34] and others.

Some doubt, however, has been thrown on the supposed stability of the antirachitic vitamine. Steenbock, Boutwell and Kent[35] have shown that the exposure of butter fat to 100° C. for four hours destroys almost completely the antirachitic vitamine. Drummond,[36] using butter fat and whale oil, shows that a temperature of 100° C. for one hour gives the same results. From the results of his experiments he advances somewhat hesitatingly the hypothesis that "fat-soluble A is not a clearly defined chemical substance, but rather that it is a labile substance, perhaps possessing characteristics resembling those of an enzyme." Owing to these conflicting views it is obvious that further work will have to be done to establish the validity of one or the other. *Nevertheless, it has been demonstrated that low temperatures, for example, from 40° to 50° C., have no deleterious influence on the activity of the vitamines.*

The vitamine preparation is a grayish-white powder, practically odorless, slightly sweet when prepared for ingestion and devoid of toxic properties. It is stable, non-hygroscopic, sparingly soluble in water and strong organic acids, much more soluble in dilute acids and gastric juice and practically completely soluble in concentrated mineral acids. The activity of the vitamine product has been unchanged during five months, and because of the method of preparation it will undoubtedly retain its activity for longer periods of time. It may be mentioned here that properly dried yeast has up to date retained its activity for three years.[16] It has been thought advisable to store the vitamine product in the dark to avoid any possible deleterious action of light. Regarding this precaution, Zilva[37] has found that butter exposed for eight hours to ultraviolet light undergoes very noticeable changes and loses its antirachitic value. However, similar experiments with the antineuritic vitamine of yeast and the antiscorbutic vitamine of lemon-juice shows that neither one loses its activity. As shown by Funk,[38] radium emanations have no effect on the activity of autolyzed yeast, which contains both antineuritic and antirachitic vitamines.

A tentative analysis of the vitamine product shows the following chief constituents: Calcium, expressed as calcium oxide, 10 per cent.; phosphorus, 15 per cent.; nitrogen, 3.5 per cent.; fat, 2.5

per cent.; iron, 0.3 per cent.; silicates, 5.6 per cent.; moisture, 10 per cent.; the remainder is made up of the rest of the phytin molecule—of which the vitamine preparation is chiefly constituted—which is a double calcium and magnesium salt of inosite pentaphosphoric acid. *The value of the preparation, however, lies largely in its vitamine content. As for the calcium and phosphorus present, although it is impossible to attribute to them any definite therapeutic value, it is admitted that both are important in the diet, presumably for the purpose of bone and tooth formation.*[31]

As we go to press our attention is called to an editorial[39] entitled "Do Americans Need More Calcium?" The editorial goes on to say:

"Sherman[40] has come to the conclusion that 'ordinary mixed diet of Americans and Europeans, at least among dwellers in cities and towns, is probably more often deficient in calcium than in any other chemical element.' In the case of the growing individual lime must be provided for the normal development of the bones, which include 99 per cent. of this element. The pregnant mother needs calcium for the rapid increment of the fetus, and during lactation she has a similar requirement for the production of a secretion, milk, which is exceptionally rich in it. The tendency toward a shortage of calcium is not confined to the human species. "Forbes[41] has shown this to be true in the cow. The average daily calcium requirement has been estimated as a little less than 0.5 gm. per man. It is proposed by McCollum and his collaborators[42] that an addition of calcium could be most conveniently made to our foods through the use of a mixture of equal parts of common salt and calcium carbonate in the kitchen and on the table. This suggestion deserves a sympathetic hearing."

Mellanby[17] makes the point that "it is more than probable that a deficient calcium intake associated with deficient antirachitic factor will bring about a more acute production of rickets and must always be an adjuvant factor to be considered in the etiology of rickets."

In view of the foregoing, and judging from the findings recorded in Tables I to IV, it must be concluded that the presence of both calcium and phosphorus in the vitamine preparation is a distinct advantage.

SUMMARY.

We have prepared a stable vitamine product, briefly designated, "V." An analysis shows the chief components to be calcium, expressed as calcium oxide, 10 per cent.; phosphorus, 15 per cent.; nitrogen, 3.5 per cent.; fat, 2.5 per cent.; iron, 0.3 per cent.; silicates, 5.6 per cent.; moisture, 10 per cent. The remainder goes to make up the rest of the phytin molecule—the main constituent of the product—which is a double calcium and magnesium compound of inosite phosphoric acid.

Owing to the method of preparation and to the results of our experiments with normal and polyneuritic pigeons, normal and scorbutic guinea-pigs and finally with children presenting evidence of malnutrition, marasmus and rickets—a marked acceleration in the rate of growth having been obtained, particularly in the children—it is established that the product contains antineuritic, antiscorbutic and antirachitic vitamines. The calcium and phosphorus present in the product undoubtedly have a beneficial action on the general metabolism, more particularly perhaps on bone- and tooth-formation.

The pigeon and guinea-pig experiments demonstrate directly the presence of antineuritic and antiscorbutic vitamines. Regarding the latter, guinea-pigs getting the vitamine preparation have been kept free from scurvy for from forty-four to fifty-five days thus far while on a scurvy-producing diet of hay, oats and autoclaved milk. These results will be published at an early date upon the completion of the experiments. As for the antirachitic vitamine, although we know that it is present as explained earlier in this summary we intend to further demonstrate its presence by experiments similar to those of Mellanby.[17]

It is felt that until such time as the vitamines shall have been isolated and their chemical composition determined the vitamine preparation which we have produced is an admirable substitute and may be used with confidence in just such a manner as described by Voegtlin.[5] *It is not intended as a substitute for any method of treatment nor is it meant to be used in infant feeding only. Rather is it intended to be a valuable aid whenever its use is indicated. At the same time it should not be lost sight of that the diet must contain sufficient protein, fats, carbohydrates and mineral salts and that the caloric value must be adequate for the needs of the individual.*

It may be stated here that it is shortly planned to start an extended investigation, with the hope of isolating and determining the chemical composition of the vitamines.

We wish to express our appreciation of the valuable assistance given us by Mr. B. Shapiro in the laboratory throughout the entire experiment.

The authors wish to make acknowledgement of the coöperation accorded them by the staff of the Metropolitan Hospital. Dr. Walter Conley, superintendent of the institution; Dr. Benson, chief of the children's division; Dr. Bingham, orthopedist; Dr. Simonson, pediatrist, by whom the formulas were written, and his assistant, Dr. Vokes, and Dr. McHugh, of the house staff, seriously interested themselves in all of the work being done at the bedside, while Dr. Larkin and Dr. Hiss placed their counsel and every laboratory facility at our disposal. Our appreciation of the gracious and helpful advice and assistance of those mentioned is herewith gladly and properly made a part of this contribution to a study of the vitamines.

TABLE I.—PAUL P.

Period.	Day ending 1919.	Ingestion. N., gm.	Ingestion. CaO., gm.	Ingestion. P., gm.	Excretion. N., gm.	Excretion. CaO., gm.	Excretion. P., gm.	Balance. + N., gm.	Balance. + CaO., gm.	Balance. + P., gm.	Retention. N., per cent.	Retention. CaO., per cent.	Retention. P., per cent.	Wt. gain or loss, oz.
I	Mar. 29	4.641	0.998	0.633	2.200	trace	0.145	2.351	0.815	0.420	57.3	85.0	74.5	−2
	30	6.408	1.341	0.936	2.250	"	0.142	4.068	1.158	0.726				
	31	5.794	1.235	0.797	2.330	"	0.143	3.374	1.052	0.586				
	Apr. 1	6.202	1.293	0.876	2.530	"	0.153	3.582	1.110	0.655				
	2	6.389	1.298	0.930	2.270	"	0.162	4.029	1.115	0.700				
	3	6.164	1.212	0.865	2.620	"	0.167	3.454	1.029	0.630				
	4	6.336	1.350	0.974	3.400	"	0.163	2.846	1.157	0.743				
	5	6.274	1.380	0.858	2.210	"	0.142	3.974	1.197	0.648				
	Feces	..	..	..	0.760	1.470	0.544							
	Total	48.208	10.107	6.869	20.760	1.470	1.761	27.638	8.637	5.108				
II*	May 3	6.802	1.634	1.230	3.200	trace	0.199	3.247	1.256	0.890	46.5	79.3	73.2	+7
	4	7.364	1.779	1.307	3.240	"	0.193	3.769	1.401	0.973				
	5	7.145	1.738	1.267	3.140	"	0.206	3.610	1.360	0.920				
	6	8.335	2.053	1.434	3.870	"	0.219	4.110	1.675	1.074				
	7	7.769	1.962	1.363	4.310	"	0.246	3.104	1.584	0.976				
	8	7.509	1.795	1.361	4.100	"	0.213	3.054	1.417	1.008				
	Feces	..	..	..	2.130	2.270	0.850							
	Total	44.924	10.961	7.963	24.030	2.270	2.126	20.894	8.691	5.837				
III	May 24	7.070	1.686	1.103	3.790	trace	0.262	3.154	1.360	0.729	29.6	75.6	61.7	+4
	25	6.163	1.418	0.969	4.070	"	0.245	1.967	1.092	0.612				
	26	4.859	1.101	0.766	3.870	"	0.229	0.863	0.775	0.425				
	27	5.938	1.368	0.937	4.640	"	0.271	1.172	1.042	0.554				
	28	5.682	1.344	0.871	3.920	"	0.217	1.636	1.018	0.542				
	Feces	..	..	..	0.630	1.630	0.560							
	Total	29.712	6.917	4.646	20.920	1.630	1.784	8.792	5.287	2.862				

In this period, one gram of the vitamine preparation was fed daily.

TABLE II.—WILLIAM D.

Period.	Day ending 1919.	Ingestion. N., gm.	Ingestion. CaO., gm.	Ingestion. P., gm.	Excretion. N., gm.	Excretion. CaO., gm.	Excretion. P., gm.	Balance. + N., gm.	Balance. + CaO., gm.	Balance. + P., gm.	Retention. N., per cent.	Retention. CaO., per cent.	Retention. P., per cent.	Wt. gain or loss, oz.
I	Mar. 29	5.750	1.920	1.065	2.980	trace	0.175	2.341	1.170	0.778	40.5	67.0	73.8	−4
	30	6.070	2.028	1.125	3.270	"	0.177	2.371	1.478	0.836				
	31	6.810	2.270	1.260	3.000	"	0.162	3.381	1.620	0.986				
	April 1	5.520	1.840	1.020	3.110	"	0.170	1.981	1.190	0.738				
	2	5.270	1.757	0.975	2.830	"	0.158	2.011	1.107	0.705				
	3	5.830	1.945	1.080	2.860	"	0.155	2.541	1.295	0.813				
	4	4.940	1.650	0.915	2.870	"	0.170	1.641	1.000	0.633				
	5	5.830	1.945	1.080	2.990	"	0.172	2.411	1.295	0.796				
	Feces	..	..	..	3.430	5.200	0.900							
	Total	46.020	15.755	8.520	27.340	5.200	2.239	18.680	10.555	6.281				
II*	May 3	7.110	2.427	1.450	3.510	trace	0.284	2.930	1.664	1.018	34.0	70.9	69.6	±0
	4	7.490	2.555	1.450	3.690	"	0.288	3.130	1.792	1.014				
	5	7.800	2.662	1.580	3.710	"	0.309	3.420	1.899	1.123				
	6	7.800	2.662	1.580	4.900	"	0.382	2.230	1.899	1.050				
	7	7.160	2.447	1.460	4.590	"	0.356	1.900	1.784	0.954				
	8	8.630	2.932	1.730	4.640	"	0.331	2.320	2.169	1.251				
	Feces	..	..	..	4.020	4.580	0.890							
	Total	45.990	15.685	9.320	29.060	4.580	2.840	16.930	11.105	6.480				
III	May 24	8.420	2.810	1.560	3.290	trace	0.240	4.902	2.234	1.198	37.0	73.0	65.0	+2
	25	5.830	1.945	1.080	3.620	"	0.294	1.982	1.369	0.564				
	26	5.830	1.945	1.080	3.660	"	0.292	1.942	1.369	0.666				
	27	5.520	1.840	1.020	3.830	"	0.288	1.462	1.264	0.610				
	28	6.320	2.110	1.070	4.580	"	0.341	1.512	1.534	0.607				
	Feces	..	..	..	1.140	2.880	0.610							
	Total	31.920	10.650	5.910	20.120	2.880	2.065	11.800	7.770	3.845				

In this period, one gram of the vitamine preparation was fed daily.

TABLE III.—RAFFAEL DE M.

Period	Day ending 1919.	Ingestion. N., gm.	Ingestion. CaO., gm.	Ingestion. P., gm.	Excretion. N., gm.	Excretion. CaO., gm.	Excretion. P., gm.	Balance. + N., gm.	Balance. + CaO., gm.	Balance. + P., gm.	Retention. N., per cent.	Retention. CaO., per cent.	Retention. P., per cent.	Wt. gain or loss, oz.
I	Mar. 29	7.026	3.731	1.949	3.740	trace	0.238	3.071	2.959	1.489	44.4	79.2	76.0	+8
	30	7.021	3.765	2.017	4.660	"	0.288	2.146	2.993	1.507				
	31	7.021	3.765	2.017	3.060	"	0.195	3.746	2.993	1.600				
	April 1	7.021	3.765	2.017	3.070	"	0.345	3.736	2.993	1.450				
	2	6.916	3.650	1.959	3.370	"	0.210	3.331	2.878	1.527				
	3	7.156	3.810	2.042	3.730	"	0.249	3.211	3.038	1.571				
	4	7.156	3.810	2.042	4.020	"	0.310	2.921	3.038	1.510				
	5	7.156	3.810	2.042	4.050	"	0.250	2.891	3.038	1.570				
	Feces	..	..	..	1.720	6.180	1.780							
	Total	56.473	30.096	16.085	31.420	6.180	3.865	25.053	23.916	12.220				
II*	May 3	7.132	3.877	2.181	4.340	trace	0.265	2.401	2.697	1.671	27.5	69.5	75.0	−2
	4	7.132	3.877	2.181	4.780	"	0.286	1.961	2.697	1.650				
	5	7.132	3.877	2.181	4.550	"	0.306	2.191	2.697	1.630				
	6	7.132	3.877	2.181	5.010	"	0.312	1.731	2.697	1.624				
	7	7.132	3.877	2.181	4.910	"	0.286	1.831	2.697	1.650				
	8	7.132	3.877	2.181	5.080	"	0.341	1.661	2.697	1.595				
	Feces	..	..	..	2.350	7.080	1.470							
	Total	42.792	23.262	13.086	31.020	7.080	3.266	11.772	16.182	9.820				
III	May 24	7.462	3.850	2.075	6.580	trace	0.401	0.451	1.682	1.334	17.6	49.9	64.9	−5
	25	7.437	3.874	2.085	4.430	"	0.303	2.577	1.706	1.442				
	26	7.522	3.890	2.096	5.970	"	0.373	1.122	1.722	1.383				
	27	7.622	3.424	1.873	5.900	"	0.377	1.292	1.256	1.156				
	28	7.599	3.602	1.957	5.950	"	0.392	1.219	1.434	1.225				
	Feces	..	..	..	2.150	10.840	1.700							
	Total	37.642	21.640	10.086	30.980	10.840	3.546	6.662	10.800	6.540				

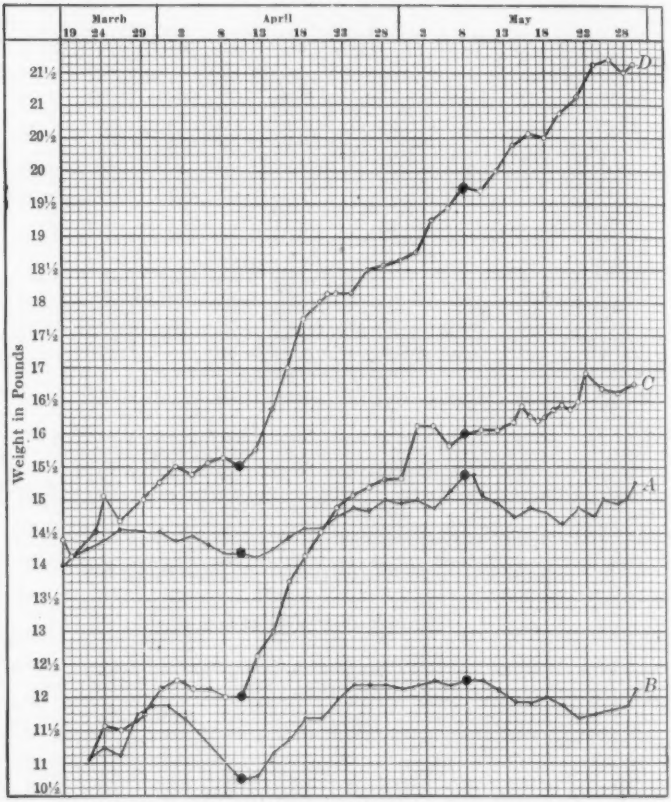
In this period, one gram of the vitamine preparation was fed daily.

TABLE IV.—MICHAEL S.

Period.	Day ending 1919.	Ingestion. N., gm.	Ingestion. CaO., gm.	Ingestion. P., gm.	Excretion. N., gm.	Excretion. CaO., gm.	Excretion. P., gm.	Balance. + N., gm.	Balance. + CaO., gm.	Balance. + P., gm.	Retention. N., per cent.	Retention. CaO., per cent.	Retention. P., per cent.	Wt. gain or loss, oz.
I	Mar. 29	2.150	0.815	0.498	1.340	trace	0.057	0.598	0.442	0.318	47.1	59.5	75.5	+6
	30	1.794	0.490	0.361	1.400	"	0.050	0.182	0.117	0.188				
	31	2.204	0.614	0.449	1.480	"	0.059	0.512	0.241	0.267				
	April 1	3.583	0.964	0.740	1.460	"	0.061	1.911	0.591	0.566				
	2	4.734	1.155	1.018	1.950	"	0.071	2.572	0.782	0.824				
	3	4.983	1.115	1.106	1.830	"	0.074	2.941	0.742	0.909				
	4	4.641	1.112	1.007	1.990	"	0.086	2.439	0.739	0.798				
	5	4.797	1.116	1.049	2.140	"	0.081	2.445	0.743	0.845				
	Feces	..	..	..	1.700	2.990	0.990							
	Total	28.886	7.381	6.228	15.290	2.990	1.529	13.596	4.391	4.699				
II*	May 3	6.584	1.223	1.702	2.810	trace	0.149	3.274	0.743	1.450	42.3	60.5	82.2	+12
	4	6.719	1.229	1.747	2.910	"	0.164	3.309	0.749	1.480				
	5	6.462	1.223	1.665	2.980	"	0.187	2.982	0.743	1.375				
	6	6.491	1.222	1.674	3.740	"	0.218	2.251	0.742	1.353				
	7	6.147	1.170	1.589	3.490	"	0.249	2.157	0.690	1.337				
	8	6.667	1.227	1.723	3.620	"	0.201	2.547	0.747	1.419				
	Feces	..	..	..	3.000	2.880	0.620							
	Total	39.070	7.294	10.100	22.550	2.880	1.788	16.520	4.414	9.312				
III	May 24	6.578	1.156	1.569	3.480	trace	0.185	2.916	0.662	1.296	34.0	57.2	79.8	−2
	25	6.413	1.152	1.521	5.440	"	0.336	0.791	0.658	1.097				
	26	6.608	1.156	1.577	4.490	"	0.239	1.936	0.662	1.250				
	27	6.481	1.153	1.541	2.990	"	0.144	3.309	0.659	1.309				
	28	6.570	1.155	1.567	4.240	"	0.228	2.148	0.661	1.251				
	Feces	..	..	..	0.910	2.470	0.439							
	Total	32.650	5.772	7.775	21.550	2.470	1.571	11.100	3.302	6.204				

In this period, one gram of the vitamine preparation was fed daily.

CHART I.



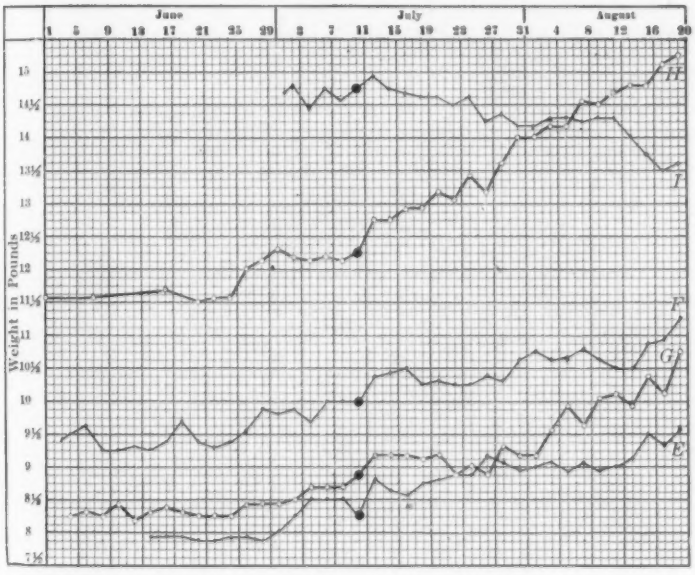
A. Paul P., 19.0 months old at start of experiment.
B. William D., 14.0 " " " " "
C. Raffael DeM., 10.3 " " " " "
D. Michael S., 18.3 " " " " "
● Feeding of vitamine preparation from April 10 to May 8, 1 gram per day.

TABLE V.

PATIENT	FORE PERIOD I	VITAMINE PERIOD II	AFTER PERIOD III
	OUNCES	OUNCES	OUNCES
Paul P.	3/19–4/10=22 days + 3	4/10–5/8=28 days +19	5/8–5/29=21 days – 2
Wm. D.	3/22–4/10=19 days – 5	+24	– 2
Raffael DeM.	3/22–4/10=19 days +15	+62	+12
Michael S.	3/19–4/10=22 days +18	+68	+30

* Controls, no vitamine given.
‡ Twin brothers, ruled out of the experiment because of chronic catarrhal enteritis.

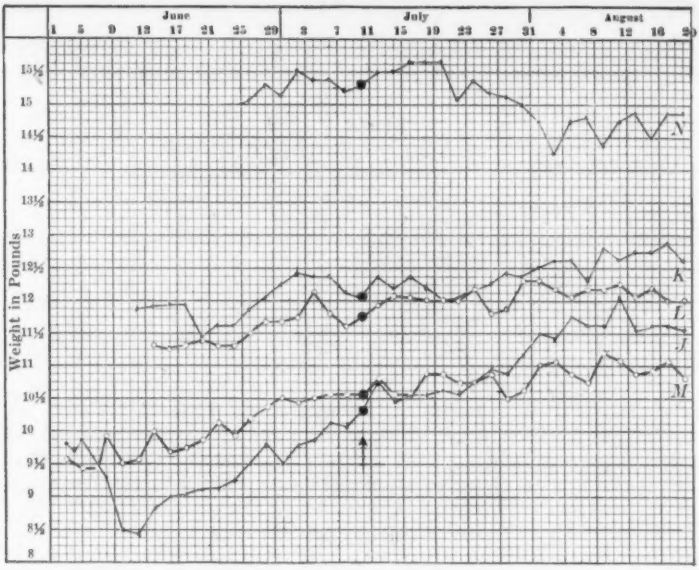
CHART II.



E. John C., 4.5 months old at start of experiment.
F. Helen B., 8.25 " " " " "
G. Anna DaV., 7.5 " " " " "
H. Walter McK., 8.66 " " " " "
I. John P., 11.00 " " " " " This baby was ruled out of experiment because of chronic catarrhal enteritis

● Feeding of vitamine preparation from July 10 to end of experiment, 1 gram daily until August 12 and 2 grams daily thereafter.

CHART III.



J. John R., 4.5 months old at start of experiment.
K. John W., 8.0 " " " " "
L. Frank M., 7.75 " " " " "
M. Herbert W., 7.75 " " " " "
N. William P., 11.00 " " " " " Twin brother of John P. also ruled out of experiment because of chronic catarrhalis enteritis.

† Beginning of period for comparison with vitamine-fed babies.

TABLE VI.

PATIENT	FORE PERIOD I	VITAMINE PERIOD II
LOT V.	OUNCES	OUNCES
John C.	6/14–7/10=26 days **+ 5**	7/10–8/19=40 days **+21**
Helen B.	6/3–7/10=37 days **+ 9**	**+20**
Anna DaV.	6/4–7/10=36 days **+10**	**+30**
Walter McK.	6/1–7/10=39 days **+11**	**+48**
John P.‡	7/1–7/10= 9 days **+ 1**	**−18**
LOT C.*		
John R.	6/3–7/10=37 days **+ 8**	**+20**
John W.	6/12–7/10=28 days **+ 3**	**+ 7**
Frank M.	6/14–7/10=26 days **+ 7**	**+ 4**
Herbert W.	6/3–7/10=38 days **+16**	**+ 4**
Wm. P.‡	6/25–7/10=15 days **+ 5**	**− 7**

TABLE VII.—SHOWING THE PERCENTAGE OF PROTEIN AND FAT, AND THE NUMBER OF CALORIES IN THE DIETS.

Patient.	P	F	C	P	F	C	P	F	C	P	F	C	P	F	C	P	F	C	P	F	C	P	F	C	P	F	C	P	F	C
	June 11			June 13			June 25			June 29			July 6			July 10			July 13			July 22			August 5*			August 12*		
John C.	1.75	2.00	414	1.75	2.00	414	2.00	2.85	564	2.14	2.42	417	2.10	2.40	518	2.10	3.00	571	2.08	2.82	560	2.57	2.97	579	2.31	2.62	556	2.65	2.14	518
	June 3			June 13			June 29			July 1			July 13			July 22			July 26			July 28			August 5			August 11		
Helen B.	1.70	1.90	540	1.84	0.52	435	2.16	0.60	437	2.10	1.20	590	2.10	0.60	515	2.10	0.60	390	2.10	0.60	375	2.10	0.60	445	2.24	0.64	463	2.24	0.64	470
	June 3			June 13			June 25			June 29			July 10			July 22			July 26*			July 28*			August 6*			August 12*		
Anna Da V.	1.50	1.71	450	1.76	1.50	515	1.66	1.90	540	1.91	2.19	593	2.09	2.38	619	2.26	2.57	645	2.42	2.76	684	2.50	2.85	696	2.50	2.85	696	2.66	2.28	640
	June 3			June 11			June 29			July 2			July 20			July 24			July 26			July 29			August 6			August 12		
Walter McK.	1.80	2.10	600	1.92	2.19	621	2.03	2.90	800	2.18	3.10	830	1.81	2.58	590	1.86	2.64	708	2.18	3.10	830	2.18	3.09	912	2.10	2.70	870	2.33	2.66	853
	June 23			July 5			July 10			July 15			July 21			July 25*			July 29*			August 1*			August 7			August 13		
John P.	2.10	2.40	860	2.10	2.40	860	2.10	1.20	710	2.10	1.20	590	2.10	1.80	665	2.10	1.80	685	2.24	0.64	544	2.38	0.68	553	2.52	0.72	562	2.52	0.72	562
	June 13			June 29			July 2			July 6			July 15			July 22			July 28			August 2			August 7			August 11		
John R.	1.65	0.47	365	1.84	1.05	426	2.02	0.57	387	2.08	1.19	494	2.04	1.04	546	2.14	1.09	553	2.26	1.18	575	2.37	1.23	665	2.46	1.22	644	2.26	1.24	595
	June 11			June 13			June 23			July 10			July 15			July 24			July 29			August 2			August 5			August 12		
John W.	1.83	2.09	700	2.33	2.66	680	1.66	1.90	554	1.83	1.57	525	1.83	2.09	580	2.10	2.38	619	2.33	2.00	588	2.42	2.07	599	2.42	2.76	671	2.52	2.16	728
	June 11			June 20			June 23			June 25			June 29*			July 10			July 22			July 28			August 5			August 17		
Frank M.	1.83	2.09	440	2.33	2.66	658	1.79	2.04	573	2.16	2.47	632	1.75	2.00	588	1.75	2.00	569	1.75	1.50	515	1.92	1.64	536	2.00	1.71	546	2.33	1.33	518
	June 3			June 13			June 23			July 15			July 17			July 20			July 24			July 28			August 5			August 12		
Herbert W.	1.83	2.09	560	2.50	1.60	578	1.50	1.28	483	1.66	1.42	504	1.75	1.50	515	1.83	1.57	525	2.00	1.70	546	2.10	1.75	565	2.00	2.28	606	2.20	2.30	635
	June 24			July 5			July 10			July 15			July 21			July 26			July 30			August 1			August 5			August 11		
William P.	2.10	2.40	860	2.90	3.02	826	2.38	2.72	792	2.38	3.40	877	2.50	2.85	684	2.66	0.76	470	2.66	0.76	312	2.66	0.76	470	2.83	0.80	481	2.80	0.80	570

P = Protein in diet, per cent.
F = Fat in diet, per cent.
C = Calories.
* = Malt soup used as diluent instead of barley gruel.

Diets usually consisted of milk, dextrinised barley gruel and one grain of sodium citrate to the ounce. Changes in the diet were made on the days indicated, as it appeared necessary.

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REVIEWS.

HYGIENE AND SANITATION. By SENECA EGBERT, A.M., M.D., Professor of Hygiene, University of Pennsylvania; formerly Professor of Hygiene and Dean of the Medico-Chirurgical College. Seventh edition. Pp. 554; 160 engravings and 5 plates. Philadelphia and New York: Lea & Febiger, 1919.

THE war if it has done nothing else has brought home the importance of hygiene and sanitation. As armies fail if they do not maintain a high standard of sanitation and hygiene, just so do civilian communities suffer if they do not enforce strict sanitary laws.

The seventh edition of this well-known work comes at a very opportune moment, and must appeal especially to ex-service men. To the present work have been added about nineteen engravings and about twenty-nine pages. The table of contents remains unchanged, and includes as headings, air, water, food, stimulants and beverages, personal hygiene, school hygiene, disinfection, quarantine, sewage, industrial hygiene, vital statistics and the examination of air, water and food. The text of the first two hundred and fifty pages remains practically unchanged. Several new paragraphs are introduced, dealing with the question of vitamins. The author in his preface makes a plea for his plan of retaining much of the old material and having omitted some new matters. This is to be regretted, for much that is new and sound by experience and experiment might have been included. The biggest change is made in the chapter on military hygiene, in which some statistical facts and other matter have been added to the text as it formerly read in the sixth edition. Some new engravings have been inserted in this chapter. The paragraphs on sewage disposal have received some revision, and are worth while.

The book remains a well-done manual, covering the field of sanitation and hygiene. The subject-matter is dealt with in a consistently sound fashion, along well-recognized lines, and holds the reader's interest, although handling material of a stabilized character. Seven editions is no mean record for a work on hygiene and sanitation, a tribute to the character of the book. T. G. S.

MANUAL OF OBSTETRICS. By EDWARD P. DAVIS, A.M., M.D., F.A.C.S., Professor of Obstretics in the Jefferson Medical College. Second edition. Pp. 478; 163 illustrations. Philadelphia and London: W. B. Saunders Company, 1919.

THERE is undoubtedly a definite place in the medical library for the books known as manuals which are usually of such a nature as to place them between quiz compends and complete text-books. The scope of the volume under consideration is such that the book may be said to be a text-book of obstetrics compressed into a manual. Although it is of a very convenient size it is remarkable how much of real value has been embraced by the author. Of the new material that has been introduced into this edition, anesthesia in labor and the Porro operation are the most practical articles and are well handled. It seems a bit humorous, however, to note that one of the points mentioned in the differential diagnosis of *early* pregnancy is that the fetal movements may be felt and the heart sounds heard *after the sixth month*. The treatment of the early toxemia by means of corpus luteum injections is not mentioned although such procedures as amputation of both breasts and renal decapsulation in the treatment of eclampsia are dignified by their inclusion. The book should continue to be a valuable aid to students who want facts and want them quickly. F. B. B.

ANALES DE LA ACADEMIA DE CIENCIAS MEDICAS FISICAS Y NATURALES DE LA HABANA, Tom. lv, 1918–1919.

"The Schistosomum Mansoni in Venezuela," Dr. John Guiteras, page 22. Dr. Guiteras calls attention to the recent work of Dr. Juan Iturbe, of Caracas, who discovered the intermediate host of Schistosomum mansoni, planorbis Guadelupensis, and points out the danger of the immigration into Cuba of Chinese, Japanese, Jamaicans and Haitians, among whom the infection is common.

Dr. Agramontes, in the discussion of Dr. Guiteras's communication, calls attention to the discovery of Clonorchis sinensis for the first time in Cuba by Dr. P. L. Querens.

The "Influence of Animal Experimentation in the Progress of Medical Science," Dr. Aristides Agramontes, page 35. Dr. Agramontes, in a carefully prepared communication on the subject, after giving a brief historical sketch of the important discoveries made in medicine and physiology, based on animal experimentation, also emphasizes the erroneous attitude taken by antivivisectionists on this point.

"The Microörganisms of Influenza," Dr. Leonel Plasencia, page 473. Dr. Plasencia claims to have discovered a new microörganism, Bacillus influenza motili, as the cause of influenza.

Dr. M. Martinez Dominguez, in a communication to the Academy, "Upon the Bacteriology of Grippe," page 560, shows by cultural characteristics and experiments on man that the bacillus of Dr. Plasencia is a microörganism related to Bacillus cloacæ and that it has no etiological significance to influenza.

Dr. Manuel Ruiz Casabo, in another communication to the Academy, "Notes upon the Present Epidemic of Influenza," page 449, regards the present epidemic of influenza as the classic influenza, or grippe, and that bacteriological investigations commonly show the presence of the Bacillus influenza of Pfeiffer in association with pneumococcus, staphylococcus and micrococcus catarrhalis.

"Etiology and Treatment of Strabismus," Dr. Francisco Fernandez, page 56. According to Dr. Fernandez, concomitant strabismus is the result of a defect in the proper fusion of the images in the brain. Muscular insufficiency, myopia, hypermetropia and other affections of the eye are only predisposing factors to strabismus.

"Concerning the Center for Hunger and Thirst," Dr. Jorge Le Roy, Dr. Jose Valdez Anciano and Dr. Felipe Garcia Cañizares, page 898. According to these authors, though the plexus of Auerbach is of importance, the center for hunger and thirst is in the medulla, the pneumogastric and splanchnic nerves acting as regulators. D. R.

SYMPTOMS OF VISCERAL DISEASE. A STUDY OF THE VEGETATIVE NERVOUS SYSTEM IN ITS RELATIONSHIP TO CLINICAL MEDICINE. By FRANCIS MARION POTTENGER, A.M., M.D., LL.D., F.A.C.P., Medical Director, Pottenger Sanatorium for Diseases of the Lungs and Throat, Monrovia, Calif.; Professor of Diseases of the Chest, College of Physicians and Surgeons, Medical Department, University of Southern California, Los Angeles, Calif. Pp. 317; 86 illustrations and 9 plates. St. Louis: C. V. Mosby Company.

IT is decidedly refreshing to pick up a book which is distinctly different from the average medical text-book, a book which deals with a phase of medicine which is considered but too briefly, if at all, in our present-day didactic text-books. In this book by Dr. Pottenger a new field has been opened up to those who have not followed carefully the work of Mackenzie, Head and several others. It is written by a man who, although a specialist in pulmonary diseases, has studied internal medicine not only from the one side of pulmonary diseases but from the many sides of diseases of all the organs. He well shows that it is impossible to have as a specialty the study of one organ, and, as he says, "the human body is a unit and one part cannot be diseased without affecting other parts. No organ can be understood except in its relationship to other organs in the body as a whole."

The book is arranged in three parts: Parts I and II are the clinical study of the relation of the vegetative nervous system to diseases and symptoms and a study of the viscerogenic reflexes, while Part III is a very technical discussion of the vegetative nervous system. The most obvious criticism of the presentation of the subject which comes to the mind of the reviewer is that there is more or less repetition of many of the statements of facts and theories in the various parts of the book. In a monograph of this size repetition must be expected, but it does seem as though the same things are dwelt upon a bit too repeatedly.

The chief defect of the work itself is that many of these reflexes, such as the viscerosensory, visceromotor and so on, are only demonstrable in cases with well-marked disturbance of the vegetative nervous system. Certainly, the ordinary physician without the very keen power of observation and well-developed clinical sense of Dr. Pottenger will be unable to demonstrate some of these reflexes which he gives you the impression are relatively simple and extremely easy to demonstrate. J. H. M., JR.

THE PREVENTION OF DENTAL CARIES AND ORAL SEPSIS. By H. P. PICKERILL, M.D., Ch.B., M.D.S. (Birm.), L.D.S. (Eng.), Professor of Dentistry and Director of the Dental School in the University of Otago. Second edition. Pp. 374; 74 illustrations and 12 tables. New York: Paul B. Hoeber, 1919.

THIS is the second edition of the Royal College of Surgeons' Cartwright Prize Essay for 1910, and represents fifteen years' research into the etiology and pathology of dental caries. The writer, being a New Zealander, has been afforded exceptional opportunities for comparative studies of this disease in civilized and relatively uncivilized races. Among the Maori race, living under natural conditions, the number of persons affected with dental caries is comparatively small, while in civilized, modern races the percentage is as high as 98. Also the number of teeth affected with caries in each individual is far less in those leading natural lives than in those leading artificial or highly civilized lives.

The great part of the book is a description of exhaustive studies upon the bacteria of the mouth, the structure of the enamel of the teeth and the physical and chemical properties of the saliva. Pickerill's conclusions from his researches may be summed up as follows:

1. The two essential, attacking forces in dental caries are (*a*) the acid-forming organisms of the mouth and (*b*) the presence of fermentable carbohydrates.

2. Individual susceptibility to dental caries depends, to a great extent, upon differences in the structure, hardness, density, permeability and solubility of the enamel.

3. Studies of the saliva show that practically all the normal constituents of the saliva are, if present in sufficient amount, of value in protecting the teeth against the occurrence of dental caries; that acids, and particularly the natural organic acids, are the stimulants which excite the greatest amount of these protective substances per minute, and, moreover, give rise immediately and for a considerable time afterward to an increased alkalinity of the mouth.

4. The carbohydrates of the food being the source of the acids which initiate dental caries, the question of the lodgeability of carbohydrate foods upon the tooth surfaces is important. The lodgeability of carbohydrates upon the teeth does not depend upon the amount of inert or fibrous matter they contain, but their lodgeability or harmfulness is in direct relation to their alkalinity. In other words the saliva will more readily wash away carbohydrate foods having an acid reaction than those having a neutral or alkaline reaction.

As measures for the prevention of dental caries in civilized races the author has the following suggestions:

In order to prevent the retention of fermentable carbohydrates on or between the teeth, and so eliminate or very considerably reduce the carbohydrate factor in the production of caries, starches and sugars should never be eaten alone but should in all cases either be combined with a substance having a distinctly acid taste or they should be followed by such substances as have an "alkaline potential," and the best of these are undoubtedly the natural organic acids found in fruits and vegetables.

Both educational and legislative measures are also advocated. The educational measures suggested comprise definite lessons in oral hygiene by the teachers in primary schools, education of medical men as to its importance, and, finally, more thorough education of the dental student in the technical side of the subject. The author suggests the taxation as luxuries of sweetmeats, confectionery and fine white flour in order to decrease their general use, and legislation fostering the culture, carriage, freight and importation of fruit and fresh vegetables, so that such articles, especially fruit, may come to be regarded as common, ordinary and necessary constituents of every meal instead of being, as at present, regarded as unnecessary and too expensive for common and constant use. In addition, the prevention of dental caries must be made one of the important branches of the public health service.

Many of the problems of dental caries are to be regarded as having been by no means solved by the researches of Dr. Pickerill, and other workers in this field will no doubt disagree with many of his conclusions. At the same time his book must be looked upon as a valuable contribution to this intricate subject. R. H. I.

A Manual of Obstetrics. By John Cooke Hirst, M.D., Associate in Obstetrics, University of Pennsylvania. Pp. 485; 216 illustrations. Philadelphia and London: W. B. Saunders & Co., 1919.

This manual, which is offered primarily for the use of students, carries one over the whole range of obstetrics in a lively manner. While a certain amount of condensation of material has been necessary, the chapters so limited will still be found to contain a sufficient amount of information to one who wishes to review the subject rapidly. For the treatment of obstetric emergencies, concise directions are given as to the method of treatment which has proved most satisfactory in the hands of the author. Abnormal pelves have been divided into five groups, based upon the predominating deformities; this classification is considered as easy for the student to remember and sufficiently accurate for all practical purposes. The chapter on the mechanism of labor should make this usually mysterious process easily understood by the average student. The illustrations, chosen from many sources, have been well selected to supplement the text. The description of a method for chemical analysis of the blood on pages 192 et seq. could well have been omitted from a book of this type. The word inlet is evidently mistakenly used for the word outlet, page 223.

While it seems at times as though there were sufficient text-books on obstetrics available, yet such a manual based on many years' experience in didactic and clinical obstetrics will take a well merited place in the obstetrical library. P. F. W.

Accommodation and Refraction of the Eye. By Earnest Clarke, M.D., Ophthalmic Surgeon to the King George Hospital, London. Fourth edition. Pp. 250; 92 illustrations. New York: William Wood & Co., 1918.

This work purports to be an elaboration of the lectures on refraction and accommodation as given by Mr. Earnest Clarke at the Central London Ophthalmic Hospital and Medical Graduates' College.

As a work to be studied by one with some familiarity in the subjects dealt with, this book can be highly recommended. We doubt, however, the advisability of the tyro endeavoring to master these subjects from this volume.

The author, in his endeavor to keep the volume within a small compass, has sacrificed in parts clarity for the sake of brevity. As a rule, the outlines suggested by him for the treatment of the various forms of refractive error are wholesome, and if exception is to be taken at all, it is that he too liberally reduces the hypermetropic correction. B. F. B.

PROGRESS
OF
MEDICAL SCIENCE

MEDICINE

UNDER THE CHARGE OF

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Achylia Gastrica.—FRICKER (*Corr. Blat. f. Schweiz. Aerzte*, 1919, xlix, 1657). Achylia is rare in early life but common after middle life, and often displays no symptoms for a long period. Gastrogenous diarrhea is one of the most common symptoms. The diagnosis is easily made by a test-meal. Occult blood is rarely found. Exploratory laparotomy seemed advisable in two cases and pieces of stomach wall were obtained for histological study. In each instance marked changes were present in the mucosa, especially in the secreting cells. The cause of achlorhydria and achylia is thought by the author to be a gastritis atrophicans not only in simple achylia gastrica but also in instances of carcinoma and pyloric stenosis associated with achylia gastrica.

Suppuration and Gangrene of the Lung.—WESSLER (*Jour. Am. Med. Assn.*, 1919, lxxiii, 1918) has analyzed 100 (personally observed) cases of lung suppuration. About 94 per cent. of the cases fall into two groups: (1) those due to the aspiration of septic material into the bronchi during operations or in states of unconsciousness and (2) those dependent on the various primary lung infections. Twenty-one per cent. followed tonsillectomies and 37 per cent. were postpneumonic. Clinically there are usually foul expectoration, persistent fever and leukocytosis, and in bronchiectasis, the early development of clubbed fingers (as early as six weeks). The physical signs are notoriously uncertain. Signs of consolidation and cavitation are important if present. The extent and locality of the process is ascertained readily by roentgeno-

grams. The prognosis depends somewhat on the etiology. Nine postoperative abscesses recovered spontaneously. In each instance either cure was accomplished in two months or the process went on to the chronic stage with the usual sequelæ. Commonly empyema results and occasionally septic brain abscesses occur. The prognosis of postpneumonic instances is bad, the process leading to induration and bronchiectasis. Medical treatment consists of quieting the cough, and drainage of the abscess by change of posture. Surgical treatment may profitably be postponed for several months in instances of acute abscess. Thoracotomy with drainage or lobectomy may be attempted after the disease has become chronic. Five in the series were cured by lobectomy. Very little can be expected of thoracotomy with drainage.

Eosinophilous Myocarditis in Diphtheria.—NUZUM (*Jour. Am. Med. Assn.*, 1919, lxxiii, 1925) by various blood stains found eosinophiles in the myocardiums of seven out of twenty-nine hearts of children dead from diphtheria. None were found in hearts of children dead from other infectious diseases. The eosinophilia had apparently no relation to serum treatment nor to the severity of the clinical symptoms. Eosinophilia was never observed in the structures of the conducting system. The His bundle was studied carefully and no changes characteristic of diphtheria were found, although slight changes and especially swelling may account for the frequent cardiac irregularities in diphtheria. Other factors, as myocardial and cardiac nerve lesions, may play an important part in the causation of arryhythmias. The cause of the eosinophilous myocarditis is not known. The author reviews the various theories, and concludes that it is a result of positive chemotaxis.

Acute Ascending Paralysis Among Troops. — CASAMAJOR (*Arch. Neurol. and Psychiat.*, 1919, ii, 605) under this heading reports several instances of the interesting malady described by Gordon Holmes and Bashford and Wilson as "acute polyneuritis." Clinically there is fever from 100° to 103° F., lasting two to four days, accompanied by headache and general pains. This disappears and the patients resume their duties. After four days to a month or even six weeks a paralytic stage makes its appearance, as a rule suddenly. The legs are affected first, then the trunk and arms and finally respiratory paralysis occurs in the fatal cases. Occasionally the VII pair may be involved. The period of paralysis is usually complete in a very few days. The paralysis is flaccid, and if any musculature is spared it is in the distal portion of the limb. The sensory changes are usually of the stocking-and-glove distribution. The sphincters are usually intact. The mortality is fairly high. In non-fatal cases the paralysis slowly disappears and after six to eight months the patient has completely recovered. Pathologically there are congestion and hemorrhage in the arachnoid, thickening of the pia, absence of perivascular infiltration, increase of cellular neuroglia in the central gray, around the root fibers and in the posterior ganglions, beginning degeneration of both a secondary and primary character in the anterior horn cell and some tract cells and marked primary and secondary degeneration of the nerve fibers where they lie in the arachnoid, always most marked in the motor fibers. In the succeeding article KENNEDY (pages 621 to 627) describes the same affection under the title of "Infective Neuronitis."

Antipyretics I, II, III.—Barbour and Devenis (*Arch. Int. Med.*, Chicago, 1919, xxiv, 611). The Benedict respiration chamber was used to study the respiratory exchange of five normal subjects. The dose of acetylsalicylic acid was 1 gm. or 1 gm. 25, and the experiments were carefully controlled. It was found that the CO_2 production and the O_2 consumption were, in the majority of instances, increased, showing therefore an increased total metabolism. The average heat production increase was 6.1 per cent. over normal controls. The respiratory quotient and the pulse-rate were not altered. After the preliminary study of normal subjects the same dose of the drug was exhibited and the same procedure used in the study of five febrile patients. It was determined that acetylsalicylic acid exhibits marked antipyretic action in febrile subjects contrary to its effect on the normal controls. Heat elimination was increased 38.2 per cent. These experiments show that "acetylsalicylic acid, like other antipyretic drugs, exerts its temperature-reducing action essentially by increasing the processes of heat elimination." "This action of acetylsalicylic acid is exhibited in afebrile stages and during convalescence, with resulting subnormal temperatures." Antipyretics therefore "reduce the body temperature in fever cases (including temporarily afebrile and convalescent phases) but not in normal persons."

SURGERY

UNDER THE CHARGE OF

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Treatment of Metastatic Carcinoma of the Spine by Deep Roentgenotherapy.—Pfahler (*Surg., Gyn. and Obst.*, 1919, xxix, 236) says that the roentgen rays when applied properly and in sufficient quantity upon deep seated cancer tissue may be expected to destroy the cancer cell, and this cancer cell is replaced by healthy scar-tissue, or fibrous tissue. When the disease is located in the soft tissues, it is replaced by fibrous tissue, and when located in bone it heals by bone sclerosis. As a result of this healing process, the patient is given prolongation of life, and is made more comfortable. One cannot expect the patient to make a complete, permanent recovery, for ultimately the disease is apt to show metastases particularly in the areas not treated.

Megaduodenum.—Dubose (*Surg., Gynec. and Obst.*, 1919, xxix, 278) says that a search of the literature finds no recorded case of giant duodenum in an infant. The symptoms in his case began when the child was three days old, and the patient was first seen by Dubose when eight weeks old. Gastro-enterostomy with pyloric occlusion is the operation of choice in partial obstruction at the duodenojejunal flexure in infants

for the following reasons: The dilated stomach is drained into the jejunum. Pyloric obstruction diverts bile and pancreatic fluid into the jejunum and prevents regurgitation into the stomach. Bile, pancreatic, and duodenal fluid with the contained hormones, so greatly needed, are more largely conserved than if the pylorus were not occluded. Regurgitation into the stomach and loss of fluids is lessened through cessation of vomiting—more certainly obtained in gastro-enterostomy with pyloric occlusion than in duodenojejunostomy. Pyloric occlusion is essential. Five months have elapsed since this operation was done, and the infant weighed then 12 pounds and 8 ounces.

Futility of Bridging Nerve Defects by Means of Nerve Flaps.—STOOKEY (*Surg., Gynec. and Obst.*, 1919, xxix, 287) presents a very thorough study of clinical, experimental and anatomical data from the literature and says that the repair of nerve defects by means of nerve flaps has not been definitely supported clinically, as evidenced by a critical study of the reported cases. Experimentally it has been shown that nerve flaps do not serve as conducting paths for the downgrowing neuraxes. Nerve flaps whether central or peripheral are merely degenerated partial nerve segments. Continuity and union of neuraxes does not take place at point of suture. To avoid fallacious deductions it is important to distinguish between the level of the injury to the nerve trunk and the level at which muscular branches arise. Abnormal communicating branches are not rare, particularly between the median and ulnar. Such anomalies must be taken into consideration of any careful study of nerve injuries. Judging from the level of the lesion, muscles may not be presumed paralyzed but should be demonstrated paralyzed. Total movements may not be offered as evidence of return of function. The action of individual muscles must be given. Reports of peripheral nerve injuries, to be of value, must be accompanied by motor, sensory and electrical findings. By the formation of nerve flaps from the central stump a portion of the nerve from which neuraxes must grow is removed. Distal as well as central flaps may sever muscular branches. By reversing the flaps they are taken out of their field. Thus the downgrowing neuraxes are prevented from reaching their muscles through these muscular branches, even were regeneration to take place. The nerve flap method to bridge nerve defects should be discarded in peripheral nerve surgery.

Early Surgical and Orthopedic Treatment of Hemiplegia.—BYRNE, TAYLOR and BOORSTEIN (*Surg., Gynec. and Obst.*, 1919, xxix, 398) says that early operation within two to four weeks, or even after a much longer period, may be indicated in hemiplegia: (*a*) Where the intracranial pressure threatens medullary strangulation, no matter what the site or nature of the lesion; (*b*) in extradural hemorrhage, with or without intradural hemorrhage, or cerebral contusion, where cerebral compression threatens life or permanent disability; (*c*) in intradural hemorrhage of traumatic or spontaneous origin where cerebral compression threatens life or permanent disability; (*d*) in intracerebral hemorrhage where focal compression threatens life or permanent disability. A subtemporal decompression and evacuation of the clot is a simple procedure and should be used in every case of fresh hemiplegia where the above-mentioned indications are present. If the patient be

unconscious, an anesthetic need not be used, as the shock of the operation is small. Even in old cases of hemiplegia decompression is of benefit. Decompression should be used even in cases due to embolism or thrombosis. The deformities and contractures of hemiplegia can be prevented. Patients with hemiplegia should be put in the same category as anterior poliomyelitis and receive proper orthopedic treatments from the beginning. Plaster splints should be applied immediately to prevent contractures. Massage and exercises are indicated and should be used intelligently. Proper use of the limbs should be shown to the patients and encouraged. In old and neglected cases deformities should be corrected and recurrences prevented.

Gunshot Injuries of the Knee-joint in a Base Hospital.—DAVID (*Ann. Surg.*, 1919, lxx, 290) says that of the gunshot wounds of the knee coming to a base hospital after operation, 56 per cent. remained uninfected and 44 per cent. infected. Of the infected cases, 5 required amputations, with one ensuing fatality. Infection of the joint plays the most important role in decreasing the function of the joint. Early operation at the front, thorough débridement of the wound, removal of foreign bodies and loose bone fragments from the joint, and closure of the capsule of the joint are the most important elements in preventing infection of the joint. Almost 50 per cent. of joints having fractures of the articular surfaces became infected after operation, whereas only 33 per cent. of other types of injury to the joint became infected. Of the high explosive fractures of the condyles of the femur nearly 60 per cent. were uninfected after operation. Fractures of the tibia did not do so well. Joints remaining uninfected after operation for fracture of the articular surfaces had normal motion, to 90 per cent. active motion in 70 per cent. of the cases. Whenever possible, injured or infected joints were actively mobilized after operation, but active mobilization is not practicable in all war injuries of joints. Of the infected joints, all that were by necessity immobilized had only ten degrees or less active motion two months after injury. Of those actively mobilized immediately after drainage of the joint, two had normal motion and the remainder better than twenty degrees of active motion two months after injury.

Surgical Treatment and Prognosis of Empyema Following La Grippe.—LEYVA and LEGENDRE (*Surg., Gynec. and Obst.*, 1919, xxix, 17) say that during the past year they had the privilege of treating in their war service 27 patients suffering from empyema, the empyema in all but one case following la grippe. Eight died and nineteen were cured or are recovering. They studied the cause of the high mortality and concluded that the prognosis in empyema is not based on the nature of the microorganism causing the condition but principally upon the condition of the lungs. As pleurisy starts early with grippe, they believe it is best for the patients, to treat them medically by aspiration and injection with with specific sera, until the pulmonary symptoms have subsided. At this time surgical intervention has every chance of success. The microorganism causing the pleurisy has no bearing on the type of operation to be performed. In pleurisy developing late in la grippe the pleurotomy opening must be large, extending backward; resection of a rib is a necessity. The classic treatment consisting in drainage without irrigation is the method of choice.

THERAPEUTICS

UNDER THE CHARGE OF

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Meningococcus Meningitis at Camp Lee.—HADEN (*Arch. Int. Med.*, 1919, xxiv, 514) reports a study of 31 cases of meningococcus meningitis occurring at Camp Lee. Twenty-one, or 67.7 per cent., showed unmistakable evidence of a generalized infection before there was a localization in the meninges. The mortality of the entire series was 22.6 per cent. During the period of intraspinous treatment alone and combined intraspinous and subcutaneous treatment the mortality was 37.5 per cent. On the other hand, during the period in which intraspinous and intravenous therapy was employed the mortality was 6.6 per cent. The author believes that meningococcus meningitis, in probably every case, is primarily a generalized infection, with subsequent meningeal localization. The use of immune serum intravenously makes a great advance in the treatment of the disease. He is also of the opinion that prolonged intraspinal treatment is very liable to result in permanent ill-effects from the involvement of the cauda equina and nerve roots. One advantage of intravenous treatment is that it decreases the number of intraspinal treatments necessary, thus minimizing the harmful effects of intraspinal treatment. Haden reports one case in which an active meningeal infection recovered under intravenous therapy alone.

The Activity of American Digitalis.—PRATT and MORRISON (*Jour. Am. Med. Assn.*, 1919, lxxiii, 1606) have tested 28 samples of American grown digitalis and found that the best American digitalis, both wild and cultivated, is equal in activity to the best European. Specimens of high potency have been obtained from Virginia, Nebraska, Wisconsin, Minnesota, Oregon and Washington. The majority of samples of American digitalis examined were of low potency. No less than seventeen out of twenty-five samples of American digitalis were below the stardard of strength established by the Pharmacopœia. This is also true of most of the digitalis imported from England and Germany. The average strength of the American digitalis, however, was greater than that of the imported digitalis that they examined. All digitalis should be tested biologically before it is gathered in large quantities for therapeutic use.

The Treatment of Thyrotoxicosis by Means of the Roentgen Ray.—HOLMES and MERRILL (*Jour. Am. Med. Assn.*, 1919, lxxiii, 1693) state that during the past five years they have treated at the Massachusetts

General Hospital 262 patients suffering from thyrotoxicosis by means of the roentgen ray. They think that the results have been sufficiently encouraging to warrant a more general use of this remedy. Of the 262 cases there were 133 patients who, because of insufficient data, were excluded from the analysis of their results. Of the remainder, 34 patients became clinically cured apparently as a result of the treatment. Sixty-eight patients were improved. This group was under treatment for a shorter period of time on the average and received a fewer number of treatments. Fourteen patients were either unimproved or made worse. Of this group, 2 died during the period of treatment from intercurrent disease; 1 died following operation. In one patient myxedema developed, probably as a result of overtreatment. The details of the technic of administration are given in the article. The authors believe that this method of treatment is not without danger. Too intensive treatment, especially in cases in which surgical treatment has been employed, may produce hypothyroidism, with the consequent symptoms of myxedema. Atrophy of the skin and telangiectasis may result in the region treated. The toxemia may be increased to a dangerous degree by the first treatment. Very careful dosage is essential to avoid this. In their summary the authors state that: (1) It is possible to decrease the activity of the thyroid gland and probably to destroy its glandular structure by exposure to the roentgen ray. (2) Roentgen-ray treatment when applied in cases of thyrotoxicosis produces a relief of symptoms and shortens the course of the disease. (3) A study of the basal metabolism before, during, and after treatment is of the greatest importance both as a means of diagnosis and as a check on the amount of treatment to be given. (4) The roentgen ray, accompanied by rest, should be tried in all cases of thyrotoxicosis and should be continued for a sufficient length of time to destroy at least the thymus before resorting to surgery.

Stone in the Kidney and Ureter from the Standpoint of the Clinical Surgeon.—OCHSNER (*Jour. Am. Med. Assn.*, 1919, lxxiii, 1105) advises in his article the administration of distilled water in large quantities in order to prevent the recurrence of kidney stone and renal colic. He states that he has made use of this method in an enormous number of cases, always with the result that the patients escape recurrences. For patients suffering from acute renal colic the use of morphin and atropin hypodermically, followed by the ingestion of two-ounce doses of glycerin with large quantities of distilled water, has seemed to the author to be of value in aiding the discharge of the stones spontaneously, especially when the patient was immersed in a very hot bath.

Results in the Modern Treatment of Diabetes.—GEYELIN (*Jour. Am. Med. Assn.*, 1919, lxxiii, 1202) states that as the result of his experience in the past four years in dealing with many diabetic patients treated according to the general principle laid down by Allen there are certain definite conclusions that can be drawn: (1) Diabetes in its severe and acute form is not limited to the first three decades of life but may be found at any age, although rare in persons over thirty. In his experience it is more common between fifty and seventy than between thirty and fifty. (2) Absolute adherence to the diet is essential

to a maximum degree of successful results in treatment. Otherwise unless the diabetes is very mild there is no hope. (3) Fast days and half-days are of great help in the treatment of the majority of patients, but are not necessary as routine measures in all cases at all times. (4) It is wise for a patient under treatment to realize that he is not a normal person on a normal diet and to regulate his mental and physical activities (and therefore his caloric output) by his caloric intake. (5) Exercise should be advised only in exceptional cases and in proportion to the amount of energy afforded by the caloric intake. Rest rather than exercise should be urged. (6) Long-continued diets overbalanced in fat (180 gm. and over) are harmful and their harmful effect is insidious. Aside from their immediate effects in the production of acidosis and glycosuria they have a depressing effect on tolerance. This effect is overcome only by long periods of low caloric intake. (7) We have no cure for diabetes, but we have a greatly improved method of treatment, particularly as regards prolongation of life and the avoidance of surgical complications, as many observers who have employed the general principles of treatment advanced by Allen will testify.

PEDIATRICS

UNDER THE CHARGE OF
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The Child and the State.—SHAW (*Arch. Ped.*, August, 1919) says that a child should have the right to intelligent consideration before he is born, to be born well and to be kept well. To insure this is the purpose of all child welfare work. The State should give to all children a sound and liberal education. Every child should come periodically under direct medical and dental supervision, and if found defective should be followed up. Every child found malnourished should somehow or other be nourished and every child found verminous should somehow or other be cleansed. Skilled medical treatment should be available for every sick, diseased or defective child. Every child should be educated in a well-ventilated classroom, or in some form of open-air schoolroom or classroom. Every child should have daily, organized, physical exercise of appropriate character. No child of school age should be employed for profit except under approved conditions. The school environment and the means of education should be such as can in no way exert unfavorable or injurious influences upon the health, growth, and development of the child. Dr. S. Josephine Baker has outlined a broad scheme of reconstructon and the child. She would have in each State a department of child welfare of equal importance with other State departments. The department should be divided into the following bureaus: (1) A bureau of child-caring institutions, which would supervise orphan asylums, day nurseries, boarded-out babies,

and widows' pensions; (2) a bureau of mental hygiene, which would have charge of all matters pertaining to mentally defective children; (3) a bureau of delinquency where the relation of crime to health would be studied and the prevention of crime in children would be supervised and the courts for children would be supervised as well; (4) a bureau of recreation, which would supervise playgrounds, physical training and play; (5) a bureau of child labor with the supervision of the child in industries and the carrying out of the child labor laws from the point of view of the child and not of the employer; (6) a bureau of child hygiene with the responsibility of the health of the children and their care from the prenatal period to adolescence. This bureau would control midwives, prenatal care, prevention of infant mortality, child welfare stations, health supervision of the child of the pre-school age, medical inspection and examination of school children; (7) a bureau of child legislation to prepare a children's code which would consist of all essential legislation to protect the child from the prenatal period to adolescence.

Stammering.—KENYON (*Am. Jour. Dis. Children*, December, 1919) contends that stammering in most cases begins in early childhood as a perversion of the normal processes of speech development. This perversion of the normal speech processes is dependent on emotional disturbances arising from the necessity of developing the speech function under the trying conditions of social interrelations. Thus there are aroused in the child more or less profound manifestations of so-called social emotions. Behind this exciting cause often lie congenital foundations and environmental conditions, which tend to encourage the natural childish tendencies to excitability and emotionalism. Natural childish characteristics—impulsiveness, lack of self-control, relative absence of knowledge and reasoning, apprehensiveness—as well as the doubtful, wavering, clumsy, state of partial development of the speech function, both constitute factors which help to render the child susceptible to this manner of speech perversion. The immediate psychology of the incitation to stammering involves emotional excitement, mental confusion, and the impulsive effort to talk while in this uncertain state of mind. The result is a speech panic, in which normal control of the peripheral speech machine is for the moment lost. In the background of this immediate mental picture lie various disturbing phenomena which add to the mental confusion. The beginning perversions of the speech act are often repeated; the stress of mind behind them becomes a more or less constant status of mind. These mental and physical perversions play a harmful part in the general mental and physical physiological processes of development. Thus the susceptibility to emotionalism and excitability slowly increase both as to uncontrollableness and to intensity, as well as to the physical manifestations in the peripheral organs of speech. All of this cannot go on for months and years without having its influence in perverting the development of the character in general. The advanced stammerer becomes a stammering person, rather than an entirely normal person who stammers. This fact renders the complete eradication of the disorder exceedingly difficult and calls for the beginning of treatment at the earliest possible time, preferably at the beginning of the manifestations.

Carotinemia.—Hess and Myers (*Jour. Am. Med. Assn.*, December 6, 1919) report two cases in which this condition was found. Their attention was attracted by the yellowish complexion, which was not confined to the face but involved the entire body, with the most marked coloration of the hands, which also showed distinct signs of desquamation. The sclerotics were not at all involved. The urine was amber and the stools normally yellow. These cases appeared in a ward of about twenty-five infants and it was noted that these two babies were the only ones receiving a daily ration of carrots in addition to their milk and cereal. Then carrots were added to the dietary of two other children of about the same age. One, after an interval of about five weeks developed a yellowish tinge to the skin and after two more weeks the second infant developed a similar tinge. On omission of the carrots the skin gradually lost its yellow color and in the course of some weeks regained its normal tint. The blood as well as the plasma were found to be distinctly yellow. The pigment was soluble in purified petroleum benzin. It was evident that there was present in these cases a systemic pigmentation brought about by the introduction of an excessive amount of carotin into the body. The pigment is non-toxic and leads to no physiological disturbance. Not only carrots but also any food which contains carotin in high degree may bring about this condition. The urine becomes a yellower tint.

Antineuritic Vitamin.—Daniels, Byfield and Loughlin (*Am. Jour. Dis. Children*, December, 1919) publish the results of their observation on the babies in their clinic. They found that the addition of the antineuritic vitamin obtained from wheat embryo to the diet of babies supplied with food furnishing an adequate number of calories stimulated growth. The beneficial influence of adding a specially prepared vegetable soup in sufficient quantity as part diluent in the milk, modification for infants is apparently due to the presence of the antineuritic vitamin contained therein. Both the alcoholic soluble material of the dried soup vegetable, and the water extract stimulated growth. The fact that the artificially-fed infant requires a larger amount of food than the breast-fed infant appears to be due to the relative paucity of diluted cow's milk in the antineuritic vitamin. It is probable that failure to gain in infants and young children is often the result of an insufficient amount of the antineuritic vitamin in the food. The diets of the young should be more carefully scrutinized with this in mind.

Chemical Examination of the Blood in Children.—Chapin and Myers (*Am. Jour. Dis. Children*, December, 1919) publish their observations on the chemical examination of the blood of one hundred and forty-nine children. Thirty-eight of these were nephritics and six were diabetics. The results were practically the same as those that have been obtained in the adult, although the kidney of the child would appear to act somewhat more efficiently than the kidneys of the adult, resulting in slightly lower normal figures for the sugar, urea, creatinin and uric acid, and a slightly better phenolsulphonephthalein test. Along this line it is shown that nephritis in children does not result so quickly in urea retention as in the adult and the prognosis is therefore more favorable in early life than in later life. Also creatinin retention rarely occurs in

children, being found in only four cases of this series. Of these two died of symptoms typical of interstitial nephritis. The authors regard the blood urea as a very helpful prognostic test in the nephritis of childhood. The results of the phenolsulphonephthalein test are usually in accord with the clinical findings and the blood urea. The carbon dioxid combining power of the blood is a very reliable method of ascertaining the severity of the acidosis in the diarrheal acidosis.

OBSTETRICS

UNDER THE CHARGE OF

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Frequency of Shoulder Presentation in Different Countries.—IPPOLITO (*Gazetta degli Ospedali e dalle Cliniche*, Milan, March 2, 1919) has collected statistics from six different countries showing that the proportion of shoulder presentation ranges from 0.35 per cent. in America, 0.36 in England, 0.58 per cent. in Germany, 0.66 in France, 0.71 in Austria. On the other hand Italy has an average of 1.40 per cent. shoulder presentations. In twenty years' practice in Sicily in 10,000 deliveries Ippolito encountered shoulder presentation in 0.2 per cent. Comparing the various races it is observed that shoulder presentation becomes less frequent the taller the mothers. While least common among Anglo-Saxons, it occurs most frequent among the Slavic races of Austria. However, the distance between the lower margin of the xiphoid appendage and the upper margin of the symphysis pubis is remarkably constant in women, irrespective of their height. Sicilian women are short but the shortness is in the legs, the length of the trunk and the distance between the xiphoid cartilage and the pubes are rather above than below the average. The writer insists then that the xiphopubic measurement is a very important measurement in obstetric practice. He believes that women are useful in preventing abuses among the poor working women in factories, improperly clad and wearing corsets.

The Transmission of Rabies to the Fetus.—REMLINGER (*Bull. de la Acad. de méd.*, April 8, 1919) has made experiments which confirm Konradi's results. When rabies is inoculated into animals they may not appear out of health for from one to three months, but the young born during this time show rabies and may have died before the mother contracts the disease. In Remlinger's experience one animal developed rabies one hundred and twenty-two days after the inoculation. This was sixty-eight days after the birth of the young and thirty-eight days after the death of the last one of the young. In some cases a year elapsed before the mother died from rabies contracted from the fetus. Young animals may be apparently healthy and yet if infected in the uterus may develop rabies at any time without further contact. It has

often been said that an animal that has never been exposed to the bite cannot acquire rabies but the experiences related illustrate the fact that the fetus might become immunized by small quantities of the rabies traversing the placenta. In some cases it is thought that rabies produces other clinical pictures than that of typical hydrophobia or paralytic rabies.

The Corpus Luteum in Neurologic Practice.—CLIMACO (*Endocrinology*, March, 1919) employed corpus luteum in some cases of male neurasthenics. Organic nervous diseases and the early stages of dementia precox were treated. In these no result was obtained. It had no effect upon the blood-pressure where arteriosclerosis was present. The best results were obtained in young females, less successful in the natural menopause and where a surgical menopause had been brought about there were no results. The drug did better when given by mouth. Two grains was as large a dose as indicated. The best results were seen in cases where there was evidence that the native corpus luteum was still present, but the giving of this cannot replace the natural functions. If menstruation is discontinued because the secretion of a gland, such as the pituitary, is disturbed corpus luteum will not bring on menstruation. The writer believes that this substance has a specific action and that administered extracts do not have the same success as the native hormone, but that the extract stimulates the native corpus luteum to function.

Hemorrhage of the Newborn Successfully Treated by Transfusion.—LOWENBURG (*Jour. Am. Med. Assn.*, May 31, 1919) reports the case of a girl, two days old, brought to the hospital bleeding profusely from the mouth, nose and rectum. The attending physician reported that the child had hematemesis the second day after birth. The child when admitted was very weak and pale and the cause of the bleeding could not be found. Ten cubic centimeters of sterile horse serum was immediately administered and under the skin normal salt solution. The child continued to bleed. Examination of the mouth and nose revealed nothing to explain further bleeding. The child was apparently moribund and stuporous, dissolution seemed to be a matter of minutes. Immediate blood transfusion was decided on. The blood was injected directly into the longitudinal sinus at the posterior angle of the anterior fontanelle. The infant was removed to the operating room, the head shaved, iodin applied over the fontanelle, 80 c.c. of whole human blood. During the operation the patient ceased to breathe and was thought to be dead. The heart sounds could still be heard. Eighty cubic centimeters more of blood were injected directly into the skin of the abdomen. Artificial respiration was used and after several gasps the child breathed. The color of the child grew steadily better, the bleeding ceased almost immediately. A second transfusion was contemplated but proved unnecessary. The child went on to recovery, but had for some time an irregular temperature. Examination of blood in the beginning of the child's treatment showed hemoglobin, 20 per cent.; red cells, 1,400,000; white cells, 12,000. On March 19, 1919, hemoglobin, 65 per cent.; red blood cells, 2,360,000; white blood cells, 10,000,000. The differential count was of no interest. On April 1, 1919, hemoglobin, 80; red blood cells, 3,600,000; white blood cells, 8200.

To What Extent Must We Depend upon the Microscopic Examination to Support the Diagnosis of Ectopic Pregnancy.—CATURANI (*Am. Jour. Obst.*, June, 1919) has studied 100 specimens by microscopic examination to determine the presence or absence of ectopic pregnancy. These specimens consisted of Fallopian tubes and ovaries removed after the clinical diagnosis of ectopic gestation had been made. Of these 85 produced positive microscopical evidence of the condition. The ragged appearance of the tubes and their rupture is almost pathognomonic of ectopic pregnancy. In 42 cases of rupture only 1 was negative. Where there has been complete tubal abortion and hematosalpinx which has persisted for some time, it is difficult to find positive evidence of ectopic pregnancy. In any considerable number of cases submitted to careful microscopic examination the percentage of negative cases is small. In hematosalpinx and hematocele arising from causes other than pregnancy microscopic examination is not always conclusive. The old teaching that hematosalpinx and hematocele are nothing but accidents of ectopic pregnancy must be revised. It is safer to take the ground that ectopic pregnancy causes hematocele unless the contrary can be proved, clinical data remain of the greatest importance.

GYNECOLOGY

UNDER THE CHARGE OF

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Roentgen Therapy in Benign Bleeding.—The results that have been obtained in the gynecological department of the University of Zurich during the years from 1914 to 1918 in the treatment of benign uterine hemorrhage by means of the roentgen ray have been presented by MANDACH (*Corres.-Blatt f. Schw. Aerzte*, 1919, xlix, 1449) with much enthusiasm. During this period there were 45 cases of climacteric bleeding in which there were no demonstrable pathologic changes in the uterus or the type that is usually designated chronic metritis and which were very rebellious to internal medication. The amount of the treatment varied to some extent with the age of the patient although as a whole the average patient required 4 series before results were obtained. The series that was used consisted of a five-minute radiation in each of three fields on one day, followed radiation in three different fields on a following day and finally in three other fields on the third day. Between series there was a three weeks interval. The details of the technic that was followed are fully described by Mandach but need not be considered here. Suffice it to state that of the 45 cases of metro-

pathic bleeding, complete amenorrhea was obtained in 41; in three patients there was amenorrhea for a few months and then the menstruation returned but in very small amount, while in one patient menstruation continued unchanged in spite of the fact that she had been subjected to 16 series. Of course in all of these patients a preliminary curettage was performed in order to rule out the possibility of a malignant tumor being the cause of the disturbance. The results that were obtained in uterine fibroid cases were also very satisfactory. There were 168 cases that were subjected to the rays, most of which were bleeding freely when the treatment was undertaken. Of these patients there are 108 that have not had any bleeding for over a year, 52 have been free from bleeding for over three months but it has not yet been a year since the last treatment, so that it is too early to tell the ultimate result. Eight patients have had a return of the bleeding, but in four of these a single massive treatment served to cause a permanent amenorrhea, while in the remainder the treatment was absolutely without effect. These results are certainly very satisfactory when we consider that these patients have been freed from their chief symptom, bleeding, without any danger to life during the course of their treatment. Many of these patients had only 20 to 30 per cent. of hemoglobin when they began treatment, but the blood constantly improved and by the time the treatment was completed they were in such a condition as to be able to carry on their usual duties. The question is often asked relative to the manner in which the roentgen rays produce these results, that is, whether the influence of the rays is on the uterus itself or whether it is merely by the effect on the ovaries that the amenorrhea is produced. Mandach states that in his work he has paid special attention to the size of the uterus before and after treatment and he concludes that there is practically no change in the uterus, so far as size is concerned, in the large majority of cases. Therefore he believes that the maximum and principal effect of the rays is due to the ovarian atrophy which is analogous to a castration.

Renal Fluoroscopy at the Operating Table.—Braasch and Carman (*Jour. Am. Med. Assn.*, 1919, lxxiii, 1751) comment upon the difficulties involved in many cases of renal stone of actually finding the calculus after the patient is on the table and the kidney is exposed. It is apparent that a more accurate method of examination of the kidney at the time of operation is desirable since the usual roentgenographic examination at the operating table is an awkward procedure and requires too much time. It would seem that if fluoroscopic examination when the kidney is brought out of the wound could be made practical, the various difficulties surrounding lithotomy would be readily overcome. Taking advantage of the recent improvement in fluoroscopic apparatus, they have employed for this purpose a machine which is essentially the same as that used in the base and field hospitals of the army, with certain minor changes which make it adaptable to civilian practise. Such an instrument consists of a transformer and autotransformer enclosed in a metal cabinet mounted on large castors for portability. To the cabinet is attached a tube stand with a horizontal arm having universal joints for supporting the tube. The tube is of the Coolidge radiator self-rectifying type, mounted in a lead glass shield. The unit is small and

compact, requiring less than 2½ square feet of floor space. It is of light weight, is portable, and has no moving parts which might cause noise and vibration. The current is turned on and off either by a hand or a floor switch. These portable units may be operated from the ordinary lamp socket without special wiring. As an essential preliminary in the technic, the roentgen-ray operator should wear goggles of smoked glass for about fifteen minutes before the observation is to be made in order that he may have the necessary dark-accommodation and retinal perception. The roentgen-ray unit should be placed as close to the operating table as possible and the rays focussed through a small diaphragm so that they will pass through the delivered kidney on the fluoroscopic screen. When the fluoroscopist is ready to make the roentgenoscopic examination, the hooded screen held in the left hand is placed over the eyes and the goggles are removed and the current is turned on by means of a foot switch. In the right hand is held a sterilized metal-tipped rod 18 inches long with which the fluroscopist accurately points to the stone shadow in the kidney. The exposure is short, requiring little more than a flash and the various details can be arranged so that there is no interference with surgical asepsis.

Etiology of Tubal Pregnancy.—MILLER (*Surg., Gynec. and Obst.*, 1919, xxix, 560) has had a dozen or more cases with a history about as follows: A woman misses her period and not wishing to go through pregnancy, begins after a few days to take drugs to bring on menstruation or to produce an abortion, or perhaps she introduces catheters or other bodies into the uterus. After an interval of a few weeks, she exhibits the signs and symptoms of a tubal pregnancy and operation shows this to be the true condition. The number of such cases which he has had has been so great and the histories so typical that he has been forced to the conclusion that there is a causal relation between the taking of oxytocics, and perhaps the other measures commonly employed in the production of an early abortion, and tubal pregnancy. Although he has no definite or experimental data to confirm such a conclusion, the arguments in its favor can be briefly stated as follows: (1) Impregnation can occur just before a menstrual period. (2) The length of time between the fertilization of the ovum and its implantation in the uterine cavity is generally given as between seven and nine days, but it may be longer. (3) Anything which interferes with the passage of the ovum along the Fallopian tube is recognized as a cause of tubal pregnancy, such as tumors in the uterine wall, chronic salpingitis and torsions of the tube. Ergot and similar drugs produce contractions of the uterine muscle and perhaps of the tube and the introduction of foreign bodies into the uterine cavity likewise produces such contractions. These contractions of the uterus must interfere with the passage of the fertilized ovum down the tube and thus they would tend to the production of a tubal pregnancy. Thus it seems entirely possible to produce a tubal pregnancy in the attempts to bring on an early abortion.

Temporary Sterilization of the Female.—In those cases where it is advisable to produce a temporary sterilization of the female, TURENNE (*Surg., Gynec. and Obst.*, 1919, xxix, 577) of Uruguay has suggested the

following operation: After the integrity of the adnexa is established, the broad ligament is held with two hooked forceps in a way to present amply its anterior surface. Ten or 15 millimeters from the lower tubal border and near the ostium he makes a 15 or 20 millimeter incision in the anterior layer of the broad ligament, separates the edges of the incision and hollows out in the cellular space which separates the two layers of the ligament a little pocket sufficient to contain the tubal ostium. The ostium is folded in this pocket and sutured and for greater security it is fixed to the ligament at a separate point near the tube. In this manner the organ retains sufficient mobility, it is not violently kinked and prolonged observation does not show any circulatory disturbance of any sort. With this technic, one can be certain of being able later to do with ease a salpingostomy and to adjust the opening to the ovary.

PATHOLOGY AND BACTERIOLOGY

UNDER THE CHARGE OF
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The Fate of Bacteria Introduced into the Upper Air Passages.—A study of the localization, growth and disposal of microörganisms in the upper respiratory tract may aid materially in the study of the carrier problem, chiefly by indicating that for the development of a carrier state some anatomical anomaly or pathological condition of the upper air passages is a primary requisite. This work which was carried out with cultures of sarcina lutea, may not be directly applicable to virulent organisms. BLOOMFIELD (*Am. Rev. Tbc.*, 1919, iii, 553) employed a culture of sarcina which grew well in symbiosis with the common mouth organisms. The individuals used in the work had only minor abnormalities of the upper air passages, and none showed sarcina in preliminary cultures from the regions studied. He found that sarcina swabbed on the tongue practically disappeared within one hour. In the nose, a heavy inoculation persisted longer, but in only one out of five instances, could the organism be recovered after twenty-four hours. In the tonsillar crypts, the bacteria were no longer found after one hour in two cases out of four, and all four were clear before twenty-four hours. The pharynx was also cultured in the individuals receiving inoculations on the tongue and into the nose. The cultures indicated very little spread of organisms and no persistence in this region. These findings point to the presence of an effective mechanism for the disposal of organisms in the upper air passages. The author next gave his attention to the study of this protective mechanism. The lachrymal secretion he considers in no way bactericidal. In the nasal passages, the secretion is scanty, but here the backward sweeping of the ciliated epithelium is to be considered as well as the peculiar structure of these air passages, and the author believes that other than just

at the anterior nares, no permanent nasal flora exists. The mouth and throat, on the contrary, offer a favorable site for bacterial growth, as has been frequently shown by the presence of a definite flora even in the presence of the best possible oral hygiene. The flushing action of the abundant secretions here is a large factor of safety. The author points out that test-tube experiments are not lacking to show the inhibitory action of saliva on a variety of organisms, while studies *in vivo* have not been reported. He performed a number of well controlled experiments, which seem to indicate clearly the inhibitory and bactericidal action of saliva on sarcina lutea. This action was quite rapid, and was independent of the effect upon bacteria normally present in the saliva. In brief, he found that cultures made at intervals up to twenty-fours hours from suspensions of sarcina in saliva yielded rapidly decreasing numbers of colonies of sarcina. The number after fifteen minutes was much reduced, only an occasional microörganism could be found after one hour, and none after two hours. The reaction of the saliva had apparently no influence, as the sarcina were readily grown in media of a slightly wider range of reaction than that found in the various specimens of saliva studied. There are a number of pathogenic bacteria which have been shown to flourish better in saliva than in broth, notably the pneumococcus. The meningococcus, too, has been found to grow better in media to which a little saliva is added. It would seem that the fate of sarcina lutea is well established by the present study, but how far inference by analogy may be carried is indeed debatable. The author promises further reports on other organisms.

Histological Changes in Squamous-cell Carcinoma of the Cervix of the Uterus after Radiation.—Justification for the use of radium in medicine can usually be determined by a more or less superficial examination. The exact problem in defining the effect of radium rays on normal and pathological tissue, however, requires a thorough understanding of both the radium and the malignant growth. Although many investigators have been impressed with the marked change in the relative amounts of parenchyma and stroma following irradiation, ALTER (*Jour. Med. Res.*, 1919, xl, 241) believes that the chronological sequence of the alterations in radiumized tissues is of utmost importance and cautions against drawing the generalized conclusions from an individual type of growth. In a series of 275 cases of squamous-cell carcinoma of cervix, ample opportunity was afforded to study several specimens from the same case representing different stages after radiation. The amount of radiation varied greatly, due to the proximity of application, but the error can be reduced to the minimum if a standard dosage with a varying time factor is assumed. The histological technic consisted in the judicious employment of various fixing and staining methods. The author calls attention to the fact that most cancers of the cervix arise from the basal-cell layer and are, therefore, non-keratinizing. Immediately after radiation, there is a latent period, the duration of which varies and cannot be determined without experiments. The earliest changes are inflammatory in nature and consist in an extensive eosinophilic infiltration as well as the formation of many

young, engorged blood channels with free hemorrhage and edema. After the first week, definite changes in the tumor cells occur and remain dominant. Both the nuclei and protoplasm swell, the former becoming uniformly pyknotic and their staining affinity changing from basophilic to acidophilic. A progressive vacuolar degeneration along with the eosinophilia, suggests profound chemical destruction. The tissues nearest the radium suffer first and, depending on the treatment, may resume malignant activities or proceed to more advanced retrogression. After continued radiation, mitotic figures disappear, usually in the second week and the stroma begins its ever-increasing advance, at first becoming diffuse so that the carcinoma really resembles a sarcoma. Later, the parenchyma is split into irregular islands by bands of cellular, young connective tissue. From the third week onward the chromatin substance suffers markedly, until, with dispersion of the nuclei it forms irregular globules and a diffuse mesh-work. About nine weeks after radiation, groups of peculiar, foamy, chromatin bodies occur in the stroma which increases in amount with a consequent decrease in the parenchyma. The author calls especial attention to the primary destruction of the tumor cells by the radium rays and the secondary increase in the connective tissue, which, while never actively proliferating, increases in volume, later only to contract into the usual collagenous or hyaline scar tissue.

HYGIENE AND PUBLIC HEALTH

UNDER THE CHARGE OF

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Health Activities in Colleges and Universities.—SUNDWALL (*Public Health Reports*, No. 45, xxxiv, 2489) gives the following as a summary of an exhaustive treatment of the subject: (1) *Aims:* The University Health Service endeavors to be a most potent factor in reducing to the very minimum that large annual academic and economic loss which is due to the indisposition and illness of students. Further, its aim is to help each student entering the university to possess a healthy, vigorous, active and harmoniously developed body. The University Health Service stands for positive health. (2) *Activities:* There are three main divisions to its activities: (*a*) Personal attention, (*b*) sanitation, and (*c*) education. (*a*) The personal division is concerned with the physical examination of all students. Complete physical records should be kept. From each record can be determined in a large measure, just what procedure is necessary to keep the student in the best physical condition

during his academic life. The following are some of the branches of the work in the personal division: (*i*) Provisions for maintaining the health of the normal, healthy student by means of proper exercises, etc.; (*ii*) protection of the physically sound student from communicable diseases that are constantly creeping into the university, by the early detection and isolation of all cases of communicable disease—tuberculosis, typhoid fever, smallpox, scarlet fever, mumps, measles, etc.; (*iii*) provisions for the care and treatment of all such cases of communicable diseases; (*iv*) reconstruction-reclamation; correction of defects, advice and treatment to all subnormals; (*v*) advice to and treatment of all ill students. (*b*) Division of Sanitation: The students' environment must be made as hygienic as possible; hence this division concerns itself with the sanitary conditions affecting the student both on and off the campus. (*c*) Education: Finally, every student in the university must be made familiar with the elements of personal and public hygiene. Education in these important matters is carried on by means of courses in these subjects, daily bulletins, exhibits and lectures.

Determination of Bacteriotropic Content of Antimeningococcic Serum.—Evans (*Public Health Reports*, No. 43, xxxiv, 2375) suggests that inasmuch as the pathology of cerebrospinal meningitis indicates that the bacteriotropins are concerned in the defense of the body against the meningococcus, the determination of the content of these antibodies in therapeutic serums should be of more value than the estimation of agglutinins and complement-fixing antibodies. A grouping of meningococci in accordance with bacteriotropic determinations is given, and it is shown that there is a fair correlation of these groups and the groups established by agglutination reactions. The content of the various antibodies in different serums does not always run parallel, and the same is to be said with respect to the loss of antibodies through the operation of unfavorable influences. The test is regarded as a valuable one for the testing of commercial serums.

Field Experiments in Malaria Control.—Rose (*Jour. Am. Med. Assn.*, 1919, lxxiii, 1414) states that for the average town in our Southern States having a thousand or more inhabitants and a reasonably high infection rate, malaria control by antimosquito measures is economically feasible; it is, in fact, a sound business investment. In heavily infected regions, in which the cost of mosquito control would be prohibitive, the amount of malaria may be greatly reduced by resort to screening, to immunizing quinin, or to destroying the parasites in the blood of the human carriers. The indications would seem, in fact, to justify the hope that by the systematic application of these measures the malaria in a community may be held within reasonable bounds, and that this result may be accomplished within limits of cost that the average community may well afford. The people in these communities are prepared to provide the funds by public taxation for malaria control when they have been shown by demonstration that the program proposed will accomplish definite results that justify the expenditure. The results thus far accomplished would seem to justify continuing these field experiments until the principal procedures that have been found useful in controlling malaria have been pretty thor-

oughly tested separately and thus evaluated. It will then be possible to operate intelligently a combination program in which each control measure will be given its place and will receive varying emphasis from time to time according to the local conditions that have to be met. This freedom in the use of our tools will in turn contribute toward the object that we have in view, namely, the highest degree of malaria control consistent with a reasonably low per capita cost.

The Ultimate Seasonal Infection of Malarial Fever, with the Mosquito Carrier as the Indicator.—MAYNE (*Public Health Reports*, 1919, xxxv, 1969) believes that by the dissection of mosquitoes and the detection in this manner of those carrying malarial parasites it is possible to apply measures of protection more intelligently than otherwise. The following from the "Discussion and Summary" indicates the field of usefulness of the measure: "Protection against malarial fever through prophylactic means, afforded by a knowledge of the presence of infective organisms in the mosquito, is a measure placed at the disposal of the sanitarian. This is offered through biological research, using the insect host as an indicator. There is a date (differing for place and year) up to which time mosquitoes are infective and beyond which time they are not. After this date malaria is not contracted by man. A knowledge of terminal infection with the mosquito as an indicator has considerable sanitary value, and it can be applied in a practical way by using it as a guide in deciding on the discontinuance of sanitary protection at a time when the mosquito no longer plays a pathological role. It furnishes the basis for the determination, in a selected zone, of a time when it is safe to curtail sanitary-control measures. Thus, needless expenditures of public funds may be averted in such cases where such funds are limited to malaria control—where it is not the purpose to eradicate the mosquito merely as a pest. Applied practically, this indicator would operate in this manner: Assuming that November 1 was the date determined as that of ultimate mosquito infectibility, and it was desired to recommend the safe time at which to discontinue oiling or other larvicidal measures, allow eighteen days for complete transformation from the larval stage, and twelve days for the adult mosquito to become infective, a total of thirty days to be counted back from the date of ultimate infectibility. The date to be named for the safe discontinuance of operations against the mosquito as an infecting agency would then be October 1.

Notice to Contributors.—All communications intended for insertion in the Original Department of this JOURNAL are received only *with the distinct understanding that they are contributed exclusively to this* JOURNAL.

Contributions from abroad written in a foreign language, if on examination they are found desirable for this JOURNAL, will be translated at its expense.

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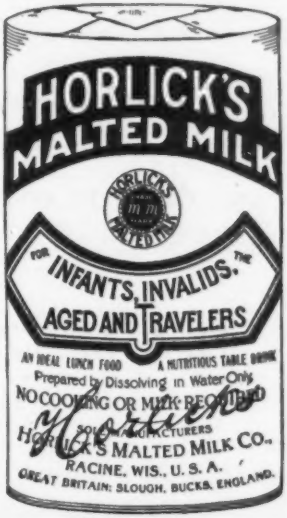
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EXAMINATIONS

FOR

APPOINTMENT IN THE MEDICAL CORPS OF THE REGULAR ARMY

THE Surgeon-General of the Army announces that preliminary examinations of all eligible applicants for appointment in the Medical Corps, U. S. Army (regular), will be held on March 15, 1920, at various points throughout the United States, in the Philippine Islands, Hawaiian Islands, Panama Canal Zone and Porto Rico, and in France, Germany and Siberia, of applicants in the military service.

The essential requirements for eligibility to take the examination are that the applicant shall be a citizen of the United States, of good moral character and habits, between twenty-two and thirty-two years of age, a graduate of a medical school legally authorized to confer the degree of Doctor of Medicine, and shall have had at least one year's postgraduate hospital interneship.

The requirement that an applicant for appointment in the Regular Medical Corps shall have served at least a year's postgraduate hospital interneship is waived in the cases of those applicants who have satisfactorily served as commissioned officers for a period of at least one year during the World War.

(See next two pages)

The Government cannot pay any portion of an applicant's expenses incurred in connection with the examination, and in designating the places of examination, due consideration will therefore be given to localities from which applications are received in order to lessen such expenses as far as possible.

The examination will be both physical and professional. The physical examination will be thorough. Candidates who fall below sixty-four inches in height will be rejected. Each candidate must certify that he labors under no physical deformity or disability which can interfere with the efficient discharge of any duty which may be required. Errors of refraction, if vision is not below 20/100 in either eye are not causes for rejection, provided they are not accompanied by ocular disease and are entirely corrected by appropriate glasses.

PHYSICAL PROPORTIONS FOR HEIGHT, WEIGHT AND CHEST MEASUREMENT

Height, inches.	Weight, pounds.	Chest measurement. At expiration, inches.	Chest measurement. Mobility, inches.
64	128	32	2
65	130	32	2
66	132	32½	2
67	134	33	2
68	141	33¼	2½
69	148	33½	2½
70	155	34	2½
71	162	34¼	2½
72	169	34¾	3
73	176	35¼	3

It is not necessary that the applicant should conform exactly to the figures indicated in the foregoing table. The following variations below standard given in the table are permissible when the applicant is active, has firm muscles and is evidently vigorous and healthy.

Height.	Chest at expiration, inches.	Weight, pounds.
64 and under 68	2	8
68 and under 69	2	12
69 and under 70	2	15
70 and upward	2	20

The professional examination will be a written one and will embrace the following subjects: Anatomy, physiology and histology, materia medica and therapeutics, surgery, practice of medicine, obstetrics and gynecology. The minimum passing mark is 80 per cent.

The Medical Corps consists of commissioned officers in number approximately equal to seven for every one thousand of the total number enlisted strength of the Regular Army as authorized from time to time by law, proportionally distributed among the grades and in the ratios as follows: Colonels, 3.16 per cent.; lieutenant-colonels, 5.42 per cent.; majors, 23.7 per cent.; captains and first lieutenants, 67.72 per cent., and two brigadiers-general in addition to the Surgeon-General, who holds commission in the grade of major-general.

Original appointments are, as required by law, made in the grade of first lieutenant, and while at the present time it is necessary that a first lieutenant serve in that grade for five years before promotion to the grade of captain, legislation has been recommended that the period be reduced to three years. Promotions to the higher grades are made as vacancies occur and all promotions are subject to examination.

To each rank is attached a fixed annual salary which is received in monthly payments, and this is increased 10 per cent. for each period of five years' service until the maximum of 40 per cent. is reached. At the present time a first lieutenant receives $2000 per annum, or $166.66 monthly; at the end of five years he receives the pay of a captain, $2400, with an increase of 10 per cent. after five years' service, making $2640 or $220 per month. After ten years' service the pay would be $2880 annually, or $240 per month. The pay attached to the rank of major is $3000 a year, which, with 10 per cent. added for each five years' service, becomes $3600 after ten years' service, $3900 after fifteen years' service, and $4000 after twenty years.

MEDICAL CORPS OF THE REGULAR ARMY

The maximum monthly pay of lieutenant-colonel, colonel and brigadier-general is $375, $416.66 and $500 respectively. Officers, in addition to their pay proper, are furnished with allowance of quarters according to rank, either in kind, or where no suitable Government building is available, by commutation; fuel and light therefore are also provided. When traveling on duty an officer receives mileage for the distance traveled, including the travel performed in joining first station after appointment as first lieutenant. On change of station he is entitled to transportation for professional books and papers and a reasonable amount of baggage at Government expense. Groceries and other articles may be purchased from the commissary at about wholesale cost price. Instruments and appliances are furnished for the use of medical officers in the performance of their duties. Well-selected professional libraries are supplied to each hospital and standard modern publications on medical and surgical subjects, including medical journals, are added from time to time. At each military post there is also a laboratory, and medical officers are encouraged to carry on any special line of professional study which appeals to them and which fits them for their duties as medical officers.

The Medical Department is operating a number of large general hospitals which offer exceptional advantages to medical officers, whose detail to duty in these institutions is made as the exigencies of the service permit so as to afford opportunity for purely professional work along the line of general medical and surgical service as well as the specialties.

Officers of the Medical Corps are entitled to the privilege of retirement after forty years' service, or at any time for disability incurred in the line of duty. On attaining the age of sixty-four they are placed on the retired list by operation of law. Retired officers receive three-fourths of the pay of their grade (salary and increase) at the time of retirement.

While the present maximum age limit for appointment in the permanent Medical Corps is fixed at thirty-two years, it is believed probable that by prospective legislation that limit may be modified somewhat in the cases of those applicants who have had military service during the World War and who are beyond the present age limit. Any such person may therefore submit application regardless of his present age in order that he may be given opportunity for examination, should the suggested change be made prior to March 15, 1920.

Applications should be in letter form, addressed directly to the Surgeon-General, United States Army, Washington, D. C., and should have embodied therein the following data in the order indicated:

(*a*) Name in full. (Initials not acceptable).
(*b*) Date of birth.
(*c*) Place of birth
(*d*) Permanent home address.
(*e*) Medical school or schools from which graduated with dates.
(*f*) Professional experience.
(*g*) If an officer who has served during the emergency—complete statement of military service, setting forth (1) the organizations in which served and inclusive dates, (2) present organization if still in the service, (3) grade in which originally appointed, (4) present grade if still in the service, (5) date, place of discharge and rank at time of discharge if no longer in the service.
(*h*) Statement of any service as a contract surgeon, in the Medical Reserve Corps, in the Medical Section, Officers' Reserve Corps, or in the Medical Service in Volunteers.
(*i*) In cases of alien birth, (1) documentary evidence of naturalization, (2) if naturalized through parent, documentary evidence of father's naturalization and sworn statements from two reputable United States citizens establishing relationship between candidate and his father.

Approved applicants will receive an invitation from the Surgeon-General, United States Army, to report to the examining board convened at the point nearest to their homes.

At the present time there are, approximately, seven hundred and thirty vacancies in the Medical Corps.

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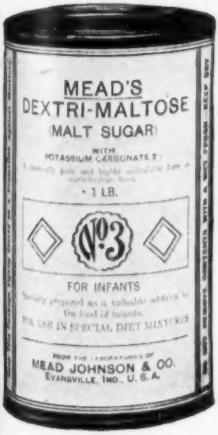

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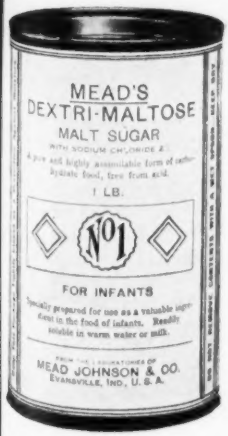

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